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AVIATION

The Oldest American Aeronautical Magazine

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The Birdmen's Perch

What goes on here, anyway? On this page, gentlemen, we print the puzzles—you solve them. I'm making a point of this because a lot of you readers of the Perch have been sending me problems and puzzles. Dandy ones, too. Only you don't send the answers with them. And how can I publish them in the Perch if I'm not sure of the right answers myself? Work 'em all out? Have a heart, fellows, and send answers with all puzzles!

Major Al Williams, alias "Tattered Wing-Tips," Mgr., Gulf Aviation Products, Gulf Building, Pittsburgh, Pa.

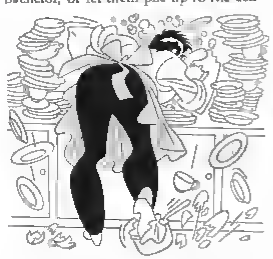
WOOING THE MUSE DEPT.

Thurman DuVall, a R W from Georgia Tech thinks so much of Gulf Aviation Gasoline that he is moved to poetry. The following little epic entitled, "G's" is reprinted with the kind permission of the author:

I think that I shall never see,
A gas as good as G A G
A fuel that gives its very best
To fly these "birds" that have no "nest"
A gas that's tops in many ways,
Used in every "crate" these days
Planes are flown by guys like me,
But only Gulf makes G.A.G!

DISHWASHING—A TO Z.

When it comes to washing dishes, there seems to be a number of different schools of thought. For instance, there is the bachelor, or let them-pile up-to the ceil



ing school. The bachelor grasps the dish and holds it under the hot water tap for a moment. He then lets the towel do most of the dirty work. Then there's the "suds" school. These folks believe in plenty of soap. They get the plates pretty clean—but the next time you use them there's liable to be a distinct flavor of soap. Of course, the ultimate in dish washing is one of those new machines that does everything but stack the dishes for you after it's through washing them. What a job those machines do!

Washing dishes and cleaning up an oil have a lot in common. (Refining oil is really a cleaning process.) There are lots of different ways to refine an oil. But you'll be glad to learn that Gulfpride is refined by the finest of these processes—the Alchlor Process. Like using a modern washing machine instead of the hot water tap—it does the job of "cleaning up" better. In fact, it removes up to 20% more impurities. That's the simplest explanation of why airmen find it does such a wonderful job—year in and year out—in their motors.

ALL SLIDE RULES BARRED!

Max J. Conklin of Lansing, Michigan, sends us this little brain addler. He's one of the people who *did* send the answer. We have it, and for the price of a post card and a few moments of your valuable time figuring this one out, we'll let you know what the answer is.

A heavily laden pursuit plane takes off from a given point and is so slow getting started that he averages only 90 M P H for the first mile.

How fast would he have to go the second mile to average 180 M P H for the two miles?

Send in your answers, boys, and don't try this in your own plane!

THIS MONTH'S WHOPPER

Dear Major:

Inasmuch as you are already being sued for $769.68 (see Nov. Whopper) I would like to file notice of suit for the sum of $10,000,000.00. It all started like this:

I was flying from St. Louis to Chicago in my little forty horse Cub, when I hit a Degonic line (a line on the Earth's surface connecting points of equal deviation.) It must have thrown me off my course because I noticed that my gasoline supply was getting low, and no sight of Chicago. I also hadn't hit any of my check points during the last six hours (you can see that I use dead pilotage) and I was really getting a little bit concerned, when the motor started to sputter and cough and finally died altogether. I quickly spotted a farmer's field and made a nice dead stick landing in a corn field. The farmer came out raving mad, but I offered to pay for the damages, and his anger rapidly faded.

I explained my predicament, and, gentleman that he was, he offered to let me have some Gulf Aviation Gasoline, which he kept

on hand to kill corn borers.

I allowed him to put two gallons in the tank and after starting the little motor first pull, I taxied back for the take off.

Waving good-by to the farmer, I gave her the gas and thereby started this whole mess. The G A G turned that little forty horse power motor over so fast that the prop wash started a tornado that wiped out three counties in Southern Illinois before they got it stopped.

The damage was estimated at $10,000,000.00 which I honestly believe is conservative, and they're suing *me*, so I'm suing *you*.

Honestly,
NORMAN P. BALLESTER
Evanston, Ill.

BREWSTER
"MODEL 339"
FIGHTER
is Equipped with

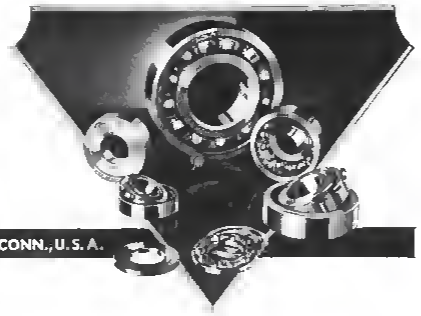
NORMA-HOFFMANN PRECISION BEARINGS

This high-speed all metal plane—the product of Brewster Aeronautical Corporation, Long Island City, N Y., and Newark, N. J—is one of the latest and fastest single-seat fighters developed in the United States. It has been supplied, and is being produced, in large numbers for the U. S. Navy, as well as for foreign governments.

NORMA HOFFMANN PRECISION BEARINGS are used in the control system in rudder pedals, bell cranks, links, and hinges for rudder, elevators, ailerons, flaps, and tabs—the points where friction-free operation, combined with rigidity and dependability, are vital.

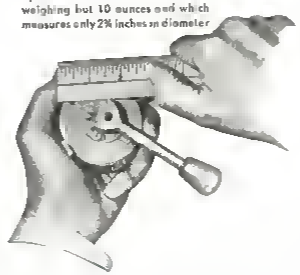
"Where the bearings must not fail"—on land, at sea or in the air—practically every representative American builder of aircraft, engines, instruments and equipment (including the U S Government) employs NORMA HOFFMANN BEARINGS Made in 108 series and in more than 3000 sizes, there is a PRECISION BEARING for virtually every aircraft application.

Write for Catalog Let our engineers work with you.



NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U.S.A.

Advanced features of design and operation have been incorporated by Bendix into a Four Way Valve weighing but 10 ounces and which measures only 2¾ inches in diameter



EXTREME compactness with light weight and reliability are combined in the new Hydraulic Four-Way Valve developed by Bendix of Burbank

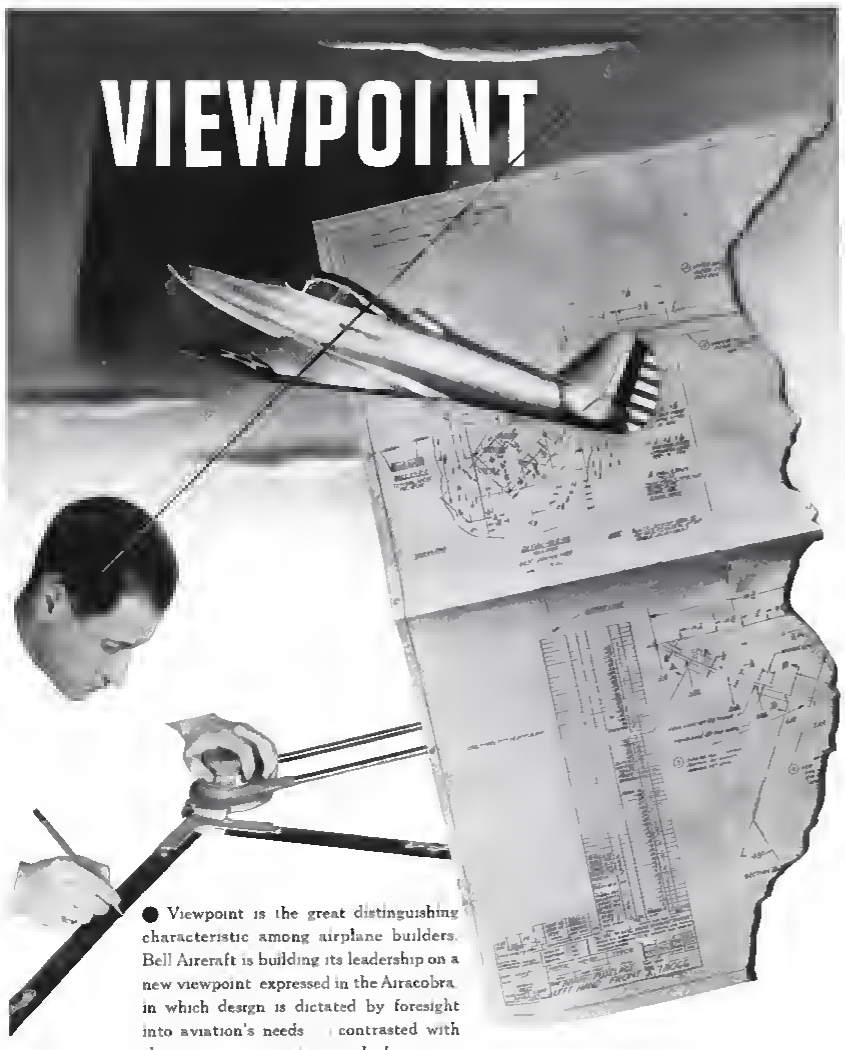
The unit incorporates poppet valve elements which radiate from a single central cam shaft This construction provides the least cubic volume and weight per square inch of port area, and results in the shortest possible fluid path Either back or side outlets are available and the valve requires a minimum of space for panel mounting

The specially designed valve elements insure smooth, quiet operation, even in excess of normal ratings, and the absolute reliability and freedom from appreciable wear of this exclusive construction has been demonstrated in life tests of over 100,000 cycles

The new Bendix Four Way Valves may be equipped with integral inlet check and thermal relief valves They are available in three sizes, covering all tube requirements from ¼ inch to ⅝ inch Write or wire for the Bendix Hydraulic Catalog

BENDIX AVIATION, LTD.
BURBANK, CALIFORNIA

CUSHION-CLAMPS • PRESSURE REGULATORS • PRESSURE WARNING SWITCHES • PRESSURE ACCUMULATORS
ACTUATING CYLINDERS • RELIEF VALVES • HYDRAULIC HAND PUMPS • CUSTOM BUILT RADIO EQUIPMENT



● Viewpoint is the great distinguishing characteristic among airplane builders. Bell Aircraft is building its leadership on a new viewpoint expressed in the Airacobra, in which design is dictated by foresight into aviation's needs . . . contrasted with the common viewpoint in which purpose is afterward found for new developments

BELL AIRCRAFT CORPORATION, BUFFALO, NEW YORK

1ST IN Sales!

50 to 65 H.P.

Lycoming 50 to 65-horsepower engines achieved FIRST PLACE in light-plane engine sales for 1940. The preference for these "stars of the skyways" in America's civilian training planes marks a growing appreciation of the Lycoming BLUE RIBBON engine's amazing economy and unfaltering reliability . . . the same championship characteristics which have long made Lycoming radials a favorite in the training planes of America's armed forces.

STARS OF THE SKYWAYS

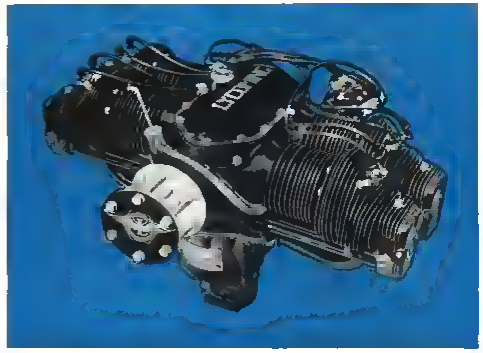
Illustrated is the Lycoming 65-horsepower engine Other four-cylinder models are available in 50, 55, 75, 100 and 125 horsepower and six-cylinder models in 150 and 175 horsepower They are all horizontally opposed and air cooled with provision for mechanical or electric starter and accessory drives

FREE LITERATURE

on Lycoming 50 to 75-horsepower light-plane engines may be obtained from all Aeronca, Funk, Luscombe, Piper, Porterfield and Taylorcraft dealers Or write Lycoming Division, Dept A31, Aviation Manufacturing Corp Williamsport, Penna., U S A Cable address Aviatcor

★

Contractors to the U S Army and Navy



YOU CAN RELY ON

LYCOMING

50 to 300 H.P.

Engines

FOR MILITARY AND CIVILIAN TRAINERS ★ FOR PRIVATE AND COMMERCIAL PLANES

To the Young Man Who Is "on the Fence"

SPARTAN OFFERS THESE PLAIN FACTS

If it is a question of what career, facts prove you can't go wrong by choosing aviation for a fascinating profession, distinction, prestige and excellent financial opportunities.

If it is a question of what aviation school, these facts should go far toward placing SPARTAN at the top of your list:

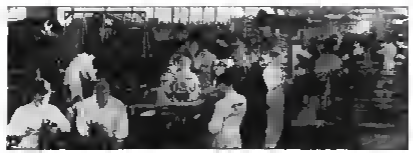
... Spartan offers you the prestige of a famous school fully approved by the U. S. Government for flight and mechanics training.

. . Spartan is located in the heart of the nation's greatest flying country.

... Spartan is now completing a $475,000 expansion program: new planes, new technical courses, new technical equipment, new air-conditioned training quarters, new comfortable dormitory, new cafeteria, new recreation quarters.

... Spartan is receiving requests for more Pilots, Mechanics, Engineers, Meteorologists, Instrument Technicians and Radio men than they can supply. Spartan flight graduates now getting immediate employment at $190 to $300 a month.

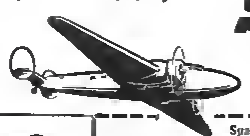
... Spartan offers you all this, *and more!* The coupon will bring you the complete story and the 1941 catalog. Mail it now!



Train in one of the most complete repair, service and overhaul departments.

One of the Spartan fleets lined up for flight.

(Next Semesters start March 31 and July 7)



SPARTAN

SCHOOL OF AERONAUTICS

DIVISION OF SPARTAN AIRCRAFT COMPANY

One of the Most Modern and Complete Schools of Its Kind in Equipment and Training Courses

Spartan School of Aeronautics—Captain Maxwell W. Balfour, Director

Address Dept. A-31, Tulsa, Oklahoma

Send me your new Catalog describing in detail the SPARTAN courses I have checked, also stating tuition and living expenses

Name ..... Age .....

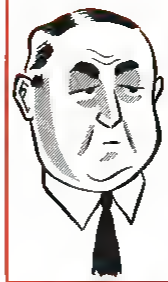
Address .....

City ..... State .....

Previous Education .....

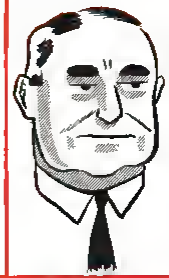
Check Courses You Prefer—

- ☐ Air Transport Pilot
- ☐ Maintenance Engineering
- ☐ Aeronautical Engineering
- ☐ Instrument Technician
- ☐ Airline Service Mechanic
- ☐ Aircraft or Engine Mechanic
- ☐ Commercial Pilot
- ☐ Instructor Rating
- ☐ Air Transport Radio
- ☐ Weather Analysis & Forecasting
- ☐ Aircraft Factory Mechanic (13)



I was worried

when I realized our production was not geared to meet delivery dates. New business had come our way, spurred by national defense. Were *we* going to lag behind?



But determined

I studied every operation . . . consulted time-and-motion experts . . . went through the plant for the hundredth time, and *there* on the assembly line . . . was a major cause of delay.

Slow work?

"Yes," said one foreman, "our screw-driving *is* slow. Can't use power drivers, for fear of driver slippage. Hand driving is hard work . . . screws go in crooked . . . screw heads split."

THE CAUSE . . .

"Old-Fashioned Fastening"

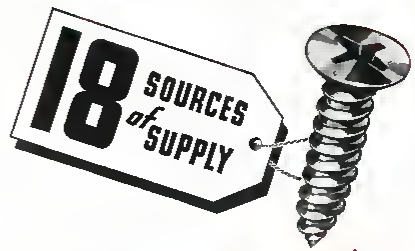
I began to notice. Screws fumbled. Driver wobbling. Help needed to steady the parts. Everywhere — waste resulted because I had insisted, *incorrectly*, that slow-driving screws *cost less!* I decided —

Don't Be Old-Fashioned

Phillips Screws Will End Slow, Wasteful Fastening

It's just good sense, I found out. The driver can't slip from the Phillips recess — so pneumatic or electric drivers can be used. No more screw driver accidents — no more delays — no more unnecessary worker fatigue. No wonder so many industries are standardizing on Phillips Screws.

Don't forget—it isn't the *price* of the screws that counts. It's the cost of *using* them. Thousands agree — *Phillips Screws cost less to use!*



PHILLIPS RECESSED HEAD SCREWS...

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS
SPECIAL THREAD-CUTTING SCREWS • SCREWS WITH LOCK WASHERS

U. S. Patents on Product and Methods Nos. 2,036,141; 2,046,837; 2,046,839; 2,082,085; 2,084,078; 2,084,079; 2,096,158. Other Domestic and Foreign Patents Allowed and Pending.

Speed Product Deliveries by Cutting Assembly Time

American Screw Co., Providence, R.I.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N.H.
The Charles Parker Co., Meriden, Conn.
Parker Kalon Corp., New York, N.Y.
Pawtucket Screw Co., Pawtucket, R.I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N.H.

R.A.F. over U.S.A.

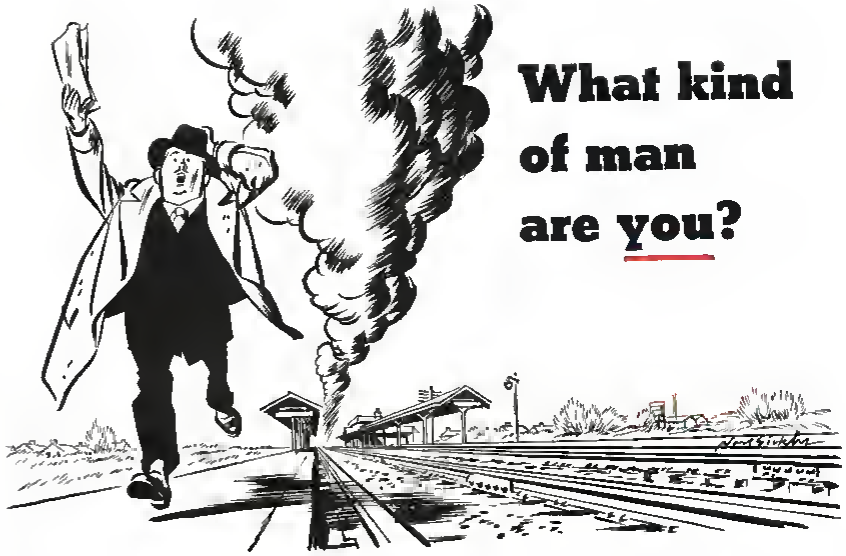
Skies over San Diego roar with test-flying of Consolidated Liberators, war camouflaged for the R. A. F.

Side by side with deliveries of U. S. Army's B24, these huge bombers roll off final assembly at Consolidated for air delivery to the front line of Democracy. Britishers say of them, "the best military airplane ever built in America".*

Men, management and money are bending every effort here to get America's first job done.

* The Aeroplane, Nov. 29, 1940.

CONSOLIDATED
Aircraft CORPORATION
ESTABLISHED 1923
SAN DIEGO, CALIFORNIA



What kind of man are you?

HAVE YOU ever skipped breakfast in order to catch the seven-fifteen?

Have you ever tossed your wife a kiss from over the left shoulder as you broke down the boulevard in a dash to the Suburban Special?

Ever spent a whole beautiful Saturday at your desk when all the time you knew how gorgeous it was out on the fairway?

If you have . . . then chances are you're one of those fellows to whom business is a highly important subject. Chances are you'd readily admit that your *business* is just about the biggest thing in your life!

And chances are, too, you already know all about a magazine called Business Week.

You probably know already how packed its pages are with the exciting, critical *news* of business. How far it reaches to keep Management informed . . . how jealously it protects the Facts, how thoroughly it probes the Rumors.

You've seen for yourself the once-a-week *job* this magazine does. And it's easy for you to see that Management *uses* its pages in a way not shared by any other magazine, of any kind.

All of which knowledge . . . if you happen to be an advertising man . . . must come in pretty handy when you're making up your budget!

And must have had something to do with the 19% gain in advertising racked up by Business Week in 1940!

Business Week
ACTIVE MANAGEMENT'S MAGAZINE

Aviation's Greatest Names Rely on Mallory Welding Tips for Better Welds

WHEREVER resistance welding is employed in the fabrication of aircraft assemblies, you will invariably find welding tips, wheels and dies of Mallory Alloys being used. They have demonstrated the same superiority in this vital field as they have in the automotive . . . and in every other industrial field which involves the permanent joining of similar or dissimilar metals with greater speed and for greater strength.

In many other phases of aviation activity Mallory serves with equal distinction. Many Mallory approved precision parts are standard original equipment in the products of the leading instrument and communications manufacturers. Electrical contacts of Mallory Metals and complete contact assemblies are the most widely used of any make by aircraft engine manufacturers.

In fact, there is scarcely a phase of aviation . . . whether it's manufacture, operation or maintenance, to which Mallory services or products are not valuable contributions.

P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA
Cable Address—PELMALLO

P.R.MALLORY & CO. Inc. MALLORY SERVES THE AVIATION, THE AVIATION INSTRUMENT AND THE AVIATION COMMUNICATION FIELD WITH WELDING TIPS, ELECTRICAL CONTACTS, SPECIAL ALLOYS, MAL-O-SIL, VIBRATORS, VIBRAPACKS CONDENSERS, ROTARY SWITCHES, SINGLE AND MULTIPLE PUSH BUTTON SWITCHES, COMMUNICATIONS HARDWARE, MOBILE BATTERY CHARGERS

PESCO
HYDRAULIC PUMPS

meet the need for higher pressures

Designers of modern aircraft find Pesco engineers alert to changing trends. For example, to meet the need for higher hydraulic pressures, particularly on military planes, they find specially designed Pesco pumps setting new standards of efficiency and capacity.

New

PLUNGER HYDRAULIC PUMP

Efficient, high capacity piston pump for hydraulic systems called on to deliver consistently high pressures at all speeds. These advantages are offered—

1. Adaptable for pressures up to 3000 p. s. i.
2. Sizes from 0.07 cu. in. displacement upward.
3. Light weight: typical unit of 0.4 cu. in. displacement for 1500 p. s. i. weighs only 3.95 lbs.
4. High efficiency at all speeds from 100 to 3000 r. p. m.
5. May be used as hydraulic motor.
6. Volumetric efficiencies up to 95%.

HIGH SPEED HYDRAULIC PUMP

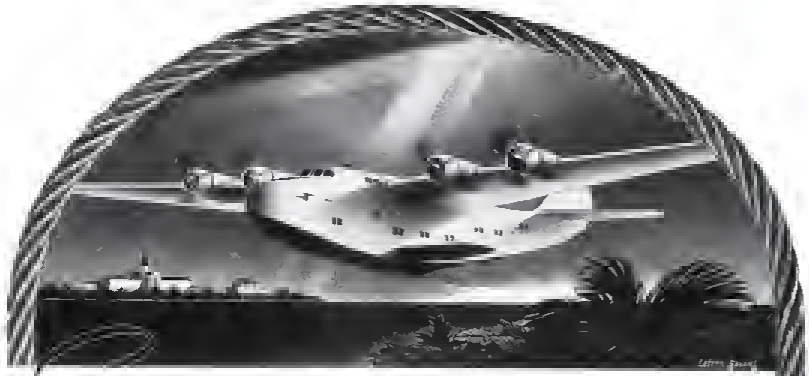
This unit provides high capacity with extremely low weight. Pump has 0.7 cu. in. displacement and weighs 2.2 lbs. Capable of pressures up to 1500 p. s. i. Recommended speeds are 2500 to 4000 r. p. m.

HAND OPERATED HYDRAULIC PUMP

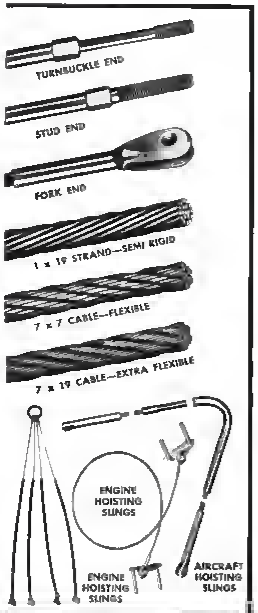
A stand-by hand pump—lighter in weight and more efficient in operation. Weighs 2.4 lbs.—providing 1.6 cu. in. displacement per cycle, for operating pressures up to 1000 p. s. i. Similar designs available for 1500 p. s. i. and more.

Other Pesco Products include fuel pumps, valves and accessories, air pumps and accessories, hydraulic cylinders and control equipment, and many other units built to order for special requirements.

PUMP ENGINEERING SERVICE CORPORATION
DIVISION BORG-WARNER CORPORATION ★ 12910 TAFT AVENUE ★ CLEVELAND, OHIO



Safety WITH HAZARD AIRCRAFT CONTROLS



● Hazard Aircraft Equipment is made by the people who have long clung to the slogan: "In Business for Your Safety." This slogan is far more than a phrase at the Hazard plant; it is an inbred doctrine. Nothing, whether materials or methods, is ever slighted or relaxed when safety is involved.

This means that Hazard control equipment is *dependable*. For instance, *all* Hazard control cables, whether "KORŌDLESS" stainless steel or Hazard tinned or galvanized strand and cable are preformed. This adds greatly to their resistance of bending fatigue—and permits the application of Hazard's TRU-LOC fitting, the 100% efficient terminal. Hazard Aircraft and Engine Hoisting Slings are equally dependable. Of course, *every* piece of Hazard aircraft equipment is made in strict accordance with the latest Army and Navy specifications.

For certain dependability—for safety of control operation—specify Hazard Aircraft Cable and Fittings.

HAZARD WIRE ROPE DIVISION
Established 1846

AMERICAN CHAIN & CABLE COMPANY, Inc. • WILKES-BARRE, PENNSYLVANIA

AIRCRAFT DEPARTMENT: 230 Park Avenue, New York City
12 251 General Motors Bldg., Detroit, Mich
2475 Porter St., Los Angeles, Calif

HAZARD *Aircraft* CONTROLS

Sentinel of Security

The *Republic* P-43

CHARGED with the defense of America's skies, the U.S. Army Air Corps has developed a swift and formidable line of pursuit aircraft.

Distinguished by its speed and fighting ability, the high-altitude Republic Aviation "Lancer" with Curtiss Electric Propellers, takes its place among those planes that are filling the exacting requirements of America's national defense.

CURTISS PROPELLER DIVISION
Curtiss-Wright Corporation · CALDWELL, N. J.

CURTISS *Electric*

Serving AIR, LAND AND SEA...

IN ALL of our defense forces of air, land, and sea, Breeze products will be found in action. Breeze equipment for aircraft, ordnance, and marine installations has long been in extensive use by both the Army and Navy.

Yet Breeze is not primarily a defense industry. It produces equipment for the airlines, for the automotive and other industries, even steel bookshelves for libraries. Now the great expansion of defense production finds Breeze equipped to supply, in addition, such vital needs as radio shielding for ignition and secondary systems, ammunition rounds counters, cartridge engine starters, and similar essentials for defense.

Expanded production has been accomplished without deviation from the rigid quality standards which Breeze has maintained in production for the aviation industry.

BREEZE MARK

Radio Ignition and Auxiliary Shielding • Multiple Circuit Electrical Connectors • Flexible Shielding Conduit and Fittings • Conduit Junction Boxes.

Cartridge Engine Starters • Dichromate Cartridge Containers • Internal Tie Rods • Propeller Pitch Controls • Elevator and Rudder Tab Controls.

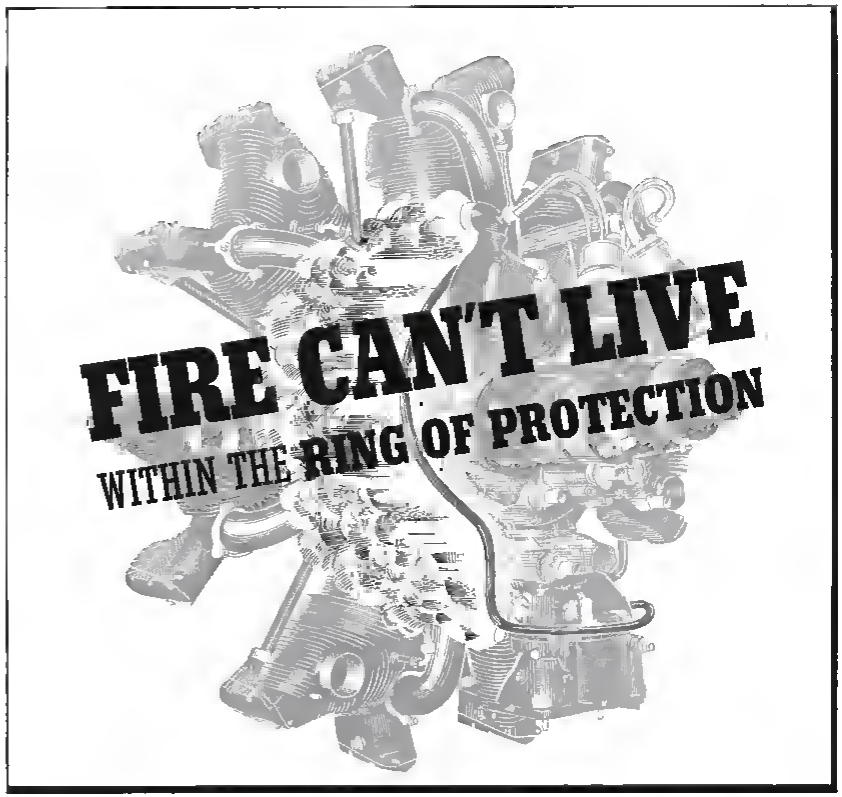
Flexible Shaft and Case Assemblies • Aeroflex Jr. Flexible Instrument Lines.

Breeze CORPORATIONS INC.
NEWARK NEW JERSEY

Tachometer Fuel Pump and Remote Control Drives • Ammunition Rounds Counters • Radio Tuning Units.

Generator and Ignition Filters • Exhaust Gas Analyzers (Fuel Air Ratio Indicators) • Flexible Metal Tubing • Resistance Type Thermometers • Swaging Machines and Tools.

Stainless Steel Division Pioneers in the design and development of stainless steel structures and fabricated products



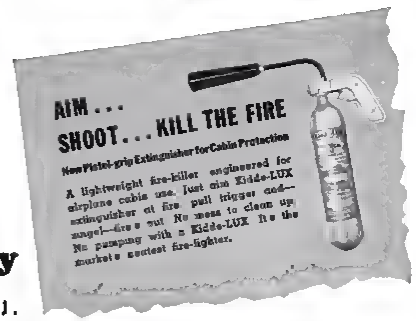
CAN you fight motor fires that occur in flight? Can you instantly detect an engine blaze? . . . kill fire in 3 or 4 seconds? *Sure you can!* Airliners, U. S. Army and Navy fighting planes have the answer. A metal ring surrounds motor, blasts fire out of existence with carbon dioxide snow-and-gas. That's LUX protection.

By combining LUX Flame Detectors with Built-in LUX system you nail fire before it gets started. Visible or audible alarm gives warning.

Directional valves permit discharge of LUX gas into any motor of a multi-engined plane. There are LUX Built-in Systems for in-line engines as well as radial.

Have you seen "White Magic"? It describes LUX Built-in fire protection for planes. Your copy is free. Send for it.

LUX



Walter Kidde & Company
INCORPORATED
322 WEST STREET, BLOOMFIELD, N. J.

AVIATION

Established 1918

OLDEST AMERICAN AERONAUTICAL MAGAZINE

OVERHEAD CONVEYORS The Glenn Martin plant has speeded up production by the use of fast overhead conveyors Large quantity orders have justified the use of this speed up method for moving 234ton PBM-1 flying boat hulls to final assembly

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FLASHES

picked up along the editorial airways

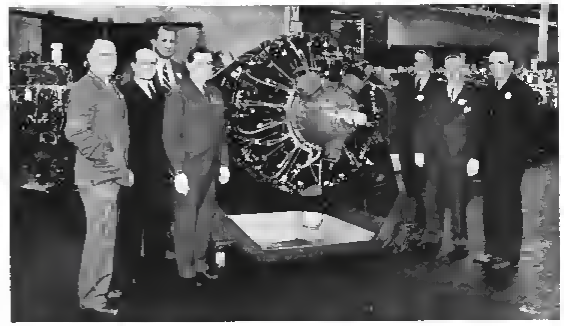
Defense Procurement Program Accelerates

» THE PROGRESS of the defense program has exceeded expectations in the past two months and is entering a phase of rapid acceleration. Aircraft production is developing much more rapidly than was generally expected. In January, 962 military airplanes were delivered out of a total production of 1054 of all types. This is somewhat better than the estimates made in AVIATION in January ("The Truth About the Defense Program"—T. P. Wright).

Of the 962 military airplanes approximately 50 percent were trainers and here Stearman reached 12 per day late in January. A large proportion of the combat ships were, as might be expected, single-engine fighters. Production of P-40s at the Curtiss Buffalo plant led the combat field, having reached 10 per day and the output of the Bell Aircraft Company, also at Buffalo, is also rapidly accelerating. Because of the increase in production of Allison engines, there are more than enough available for the needs of these two companies, and it is expected that by the time the P-38 is in quantity production, the Allison output will be sufficient to meet the needs of its three users.

Radial aircooled engine production has also made more rapid strides than might have been expected. Both large manufacturers have passed the million-horsepower-per month mark and have been delivering engines in such quantities as to make a substantial dent in the "glider lines" of airplanes previously built and awaiting engines. Although we cannot expect any substantial contribution to engine production from the newcomers in the automotive industry before Fall or the end of the year, it is reasonable to believe that this new capacity will come along in time to assist materially in the rapid acceleration of the airplane production which is just beginning and will continue throughout the year. Most recent addition to the automotive group of engine producers is Chrysler, whose intentions to manufacture a 2000 hp liquid cooled engine were announced as this was written.

The present expansion plans for engine capacity however, will probably be insufficient for the new aircraft production program which involves the use of government-owned assembly plants operated by aircraft manufacturers and using parts provided by the automotive industry. Although the final details for this program have not yet been worked out, the War Depart-



25,000th Pratt & Whitney engine. Left to right: Eugene E. Wilson, president, United Aircraft Corporation; A. V. D. Wilgoos, chief engineer; W. A. Parkins, assistant chief engineer; William Levack, assistant superintendent of assembly; G. H. D. Miller, factory manager; Daniel Jack, assistant factory manager; and L. S. Hobbs, engineering manager.

ment has announced that building contracts will soon be let for the four bomber assembly plants to be located at Omaha, Kansas City, Fort Worth, and Tulsa, and that the aircraft manufacturers concerned will be Martin, Douglas, North American, and Consolidated. Chrysler, Ford and General Motors will build parts and a production of 3600 medium and heavy bombers per year is expected.

» ENCOURAGEMENT OF SUBCONTRACTING is the next step to save time in the defense effort With this in mind the Defense Contract Service has been organized in Washington and reaches out into all parts of the country through the Federal Reserve System Each of these banks will be set up as a headquarters for exchange of views between primary contractors and possible subcontractors within its jurisdiction, and studies of subcontracting facilities available will be made Although detailed organization of the system is still under way, it would be well for aspiring subcontractors to contact their nearest Federal Reserve Bank for information on how they can be of service to the defense program. (Further details on page 90)

» MANY FALSE PROPHETS have arisen overnight to satisfy the sudden public thirst for knowledge on military aviation Some have never had a close look at a modern military airplane Many more have no adequate conception of the many unseen factors behind the airplane that make up a balanced air force So we breathed a deep sigh of relief when we saw the first copy of *Winged Warfare* by Major General H. H Arnold and Colonel Ira C. Eaker (Harper & Bros.) It goes without saying that both of these gentlemen know what it is all about.

Winged Warfare starts with the Greek triremes, moves rapidly to 1914, and winds up with the latest available material on the present air force expansion program It answers many of the questions in the confused public mind and some of those that have been troubling people close to the aviation business It is well written and easy to read even for the layman

One of the high spots is the chapter on Air Tactics, which presents many of the lessons learned in the present European War. Much light is thrown on the German success in Panzer-Stuka cooperation and how it changed basic ideas of mechanized warfare. The limitations of both light bombers and tanks acting alone are also explained. The discussion of the effective use of small, light, slow landing planes of the Fieschler-Storch type in command missions by the Germans in the Polish campaign may furnish new hopes for the future utilization of this type of equipment in military service.

In the chapter on Strategy, the important factors of timing, training, and post-war effort are emphasized The basic mistake of the present combatants in failing to provide a proper proportion of long-range bombardment aircraft in their air forces is particularly interesting and enlightening

The separate air force ideas are discussed and a policy of evolution rather than revolution toward that end appears to be the feeling of the authors, although they feel that much more thinking and planning should be done before the step is taken, if it is to be taken at all

Both sides of the question of civil aviation's part in warfare are stated and a middle ground is suggested. The importance of commercial aviation as an industry consumer to assist in leveling wartime peaks and peacetime valleys in production is stressed

Last but by no means least, the reader is impressed with the magnitude of industry's assignment to expand productive capacity at a rate unprecedented in the world's history The 36,000-plane-per-year program is discussed as is the possible need for expansion to a 50,000-plane-per-year rate And the dangers of the shadow-factory method are recited with frankness

Winged Warfare is a valuable and timely contribution to military aviation literature Its advent makes it possible for our citizens to get the truth about air power from men who are playing such a prominent part in building it for the nation

IT PAYS TO FLY

"Maguire will have to sprout more wings to carry his military load."

Side Slips

» IF YOU CAN'T FLY, you can cook. The Royal Canadian Air Force not long ago sent out a call for 375 calorie mechanics to whip up hash for the hungry hangar hounds. If you really want to pitch for democracy, get in there and try out for squadron biscuit shot. If you feel dizzy when spun on a piano stool, think nothing of it. If you can't read the top row of letters with an opera glass, you *can* still open a cannister of chipped horse and cook up a vat of bull-on-a-raft. If you can't tell red from green, never mind, you *can* pour sand in the spinach. In the blank space after "Qualifications," you can write "none" with never a worry. Why, we consumed cuisine in the late Aviation Section, Signal Corps, compounded by bull cooks who couldn't

have read a recipe even if they had wanted to. Some of those boys didn't know their aspic from a polo ground. We hear that military gastronomy is a fine art now, but that doesn't get us compensation for our duodenal disability. Yes, if you can't even fly a kite, you can cook.

» PEOPLE RIDING IN PLANES think they ought to act blase, so they read papers, play cards, talk small talk, or just sit and look bored. They have been encouraged in this by the airlines themselves, who frequently, instead of pointing up the marvels of flight, advertise pastimes to hurry and get it over with. Now, there's flying over or among clouds, it actually hurts if a friend isn't along to see it too, because words are useless. There is the propeller up, traveling as fast as the earth is turning, if that wheel was rolling on the ground it could cross the continent in three or four hours. Watch your pilots. They are different. Some lift their ships off the ground smartly. Some fly them off gracefully. Some cut their engines back immediately, others wait till they're well up. Once in a while you find a cocky one, who does harmless little things that we could tell you about. If you're artistically inclined, you'll never see a prettier picture than the landing light making a bluish white disk of the propeller at night. Why, we could look down and meditate on the patterns of *erosion* for *hours*. Stewardess! Take away those newspapers and bring us a field glass.

» THE AVERAGE PILOT, says Eastern Air Lines in a news release, is 33 years of age, 5 ft. 10 in. tall, weighs 166 lb., has blue eyes and brown hair. His temperament is complacent, controlled, his average pulse rate is 71 beats per minute. Medically speaking, his physical and mental health is so superior, one can view it only as a high tribute to his habits of good, clean living. End quote. Hallelujah!

» IF YOU LUNCH CLUB ORATORS aren't careful you'll bring on an epidemic of Alfred Lord Tennyson's "magic sail" verse. We've been running into it around every table corner lately. Just to put you on your guard, this is it—for the first and last time:

For I dipt into the future
Far as human eye could see,
Saw the vision of the world
And all the wonder that would be,
Saw the heaven filled with commerce,
Argosies of magic sails,
Pilots of the purple twilight,
Dropping down with rosty bales.

You who went through the Icarus and Daedalus crisis back in the post-Lindbergh days, will know what we mean. Ham-and-pineapple-salad speakers the country over told it an average of 42 times apiece, and the ghost writers wore it thin as a radio jive. It wasn't a bad story—the first dozen times. A couple of Greeks, Daedalus and his son Icarus, had trouble with the law on the island of Crete and decided to vamoose for Sicily. Having no other way to travel, the old man rigged up a couple of pairs of wings. For wing fittings he used wax. This proved unfortunate for young Icarus, who let himself wide out, got too close to the sun, the wax melted, and he took a Brodie into the Mediterranean. Not bad, but not good enough for a long run, even at a dollar a plate.

And neither is this dipt-into-the-future thing of Tennyson's. It isn't even

prophecy, as we are supposed to believe. Tennyson was born in 1809, twenty-six years after the Montgolfier brothers sent up their first balloon in 1783. Thus Tennyson's entire life was contemporary with balloon ascensions. Indeed the Frenchman, Blanchard, had made an ascent in the New World, witnessed by George Washington, in 1793, sixteen years before Tennyson was born. The poet almost certainly had in mind nothing more prophetic than the rather childish efforts of those times to propel balloons with sails. We do hope that this little diatribe is good enough to discourage a few incipient quoters of the "magic sail" poem.

Wide World

Germany lost so many bombers in day raids over England that now bombers make their raids only at night. These are Messerschmidts ME 110.

EFFICIENCY REPORT ON THE GERMAN AIR FORCE

Nazi raids on military objectives are far from effective, according to this British authority

By Lt. Col. W. Lockwood Marsh

Editor of the British publication, Aircraft Engineering

IT may be interesting to give some impressions of the effectiveness of the enemy aeroplane attacks that have been made on England since the occupation of northern France. It is hoped to succeed in making these observations as nearly objective as possible, and avoid exaggeration in either direction. So many rumors are in constant circulation that it is by no means easy to sift the reliability of any particular item of information, but by personal contacts checking several sources against each other, it is as a rule possible to arrive at a reasonable approximation of the facts.

It may be said at the outset that the German Air Force does not appear to be particularly successful in effecting damage on points of military importance. It seems clear that it is finding the carrying out of raids on determined and well-organized defences a very different operation from those it made in the initial stages of the war, against Poland or, in the later campaigns, against Holland, Belgium and France. Poland was not in a position to offer any effective resistance to the concentrated air attacks that were launched concurrently with the invasion and in an incredibly short space of time every aeroplane was immobilized and every aerodrome rendered useless. Holland and Belgium were no better placed—and suffered equally under the disadvantage of being subjected to surprise attack—while France, as was well known in England before the war started, but publication of the fact was not permitted, had a pitifully inadequate air force both in numbers and quality. This gave an alarming impression of the dominating effect of "air power" which has by no means been borne out up to the present by the attacks on Great Britain.

Europress

The famous Junkers Ju 87 dive bombers, which are able to pound heavy blows at relatively undefended areas but are not too effective against well-defended military objectives. All of this type that raided Croydon one day last fall were shot down.

Generally speaking—and this is said without the intention of depreciating the quality of the German pilots who are, in many instances, undoubtedly courageous and skillful—no great determination in pressing home attacks in the face of strong opposition has been shown and where it has been attempted it has not usually met with success. It has been officially stated, for instance, that in a dive-bombing attack by Ju 87's on Croydon Aerodrome, which, owing to its close proximity to London is extremely well defended, every aeroplane was lost.

The occupation of the whole of the Channel coast of France naturally gave Germany a magnificent chance, one would have thought, of rendering coastal traffic along the South Coast and through the "swept channel" of Dover impossible, and there is little doubt that there was every intention of achieving this. Repeated and heavy attacks (in some instances large numbers of machines being engaged) on convoys steaming along this route have, however, to put it mildly, not been overwhelmingly successful. That this is so is evidenced by the fact that after a week or so of repeated bombing attacks of this nature the aid of land artillery brought up to the coast of France was called in to take over, or at any rate, aid in this work. In one instance when this method also proved abortive, dive bombers were sent over to press home the attack. They did not prove any more effective, since the convoy emerged from the channel after an hour or so with no losses in ships.

During the same period efforts were made to put Dover Harbor out of action. At the end of all this effort, the London *Times* was able to publish a photograph of the harbor and town showing them to be completely undamaged—which we can confirm from the testimony of an independent and completely reliable witness on his return from there. Here again the aid of shore batteries had been called upon with some little success in causing of damage to a few houses in the town, according to British official statement.

We may here interpose an interesting sidelight on the difference in the attitude of the two countries towards the revelation of the truth in regard to the results of air raids. In a British communique of Aug. 24 it was stated with commendable frankness that "attacks were also made on the RAF aerodrome at Manston, near Ramsgate, where considerable damage was done to buildings."

Now the German News Agency of Aug. 12—a fortnight before—had claimed: "The air base of Manston was reduced to ashes. The runway had been ploughed up by bombs of all calibres, from the heaviest to incendiary bombs. The hangars and other buildings have collapsed."

It is a little difficult to visualize the need for again attacking and being able to cause "considerable damage" to an aerodrome which has already, only a fortnight before, been "reduced to ashes." It is not, in our opinion, invariably the intention of German communiques of this nature deliberately to mislead. It is rather the effect of certain arrogance and optimism in the German character which makes it difficult for a German to believe that the object of an attack can have been so disobliging as to fail to disappear. A characteristic example of this tendency was the belief that the aircraft carrier "Ark Royal" had been sunk when the ship heeled over under the influence of the helm in a sharp turn made to avoid a bomb which dropped so close as momentarily to smother her with spray, which led the crew of the aeroplane concerned to believe, and report, that she had turned over and sunk. The danger of this attitude of mind from the point of view of the inhabitants of the country being attacked is that after a time one tends to disbelieve every claim made in the German reports—a conclusion which may not invariably be justifiable.

There is no doubt whatever that the aeroplane bomb in German hands when used against defended positions is not proving to be a weapon of extreme precision. Whether this is due, as there is some reason to suppose, to the inadequacy of the German bomb sight or merely to the difficulty which undoubtedly was not fully realized in peacetime exercise of maintaining an aeroplane sufficiently long on a straight and level course in the face of A.A. and hostile aeroplane attack to ensure accuracy, is not clear, though the fact that the British aeroplane seems unquestionably more successful in hitting their actual objectives rather points to the former explanation.

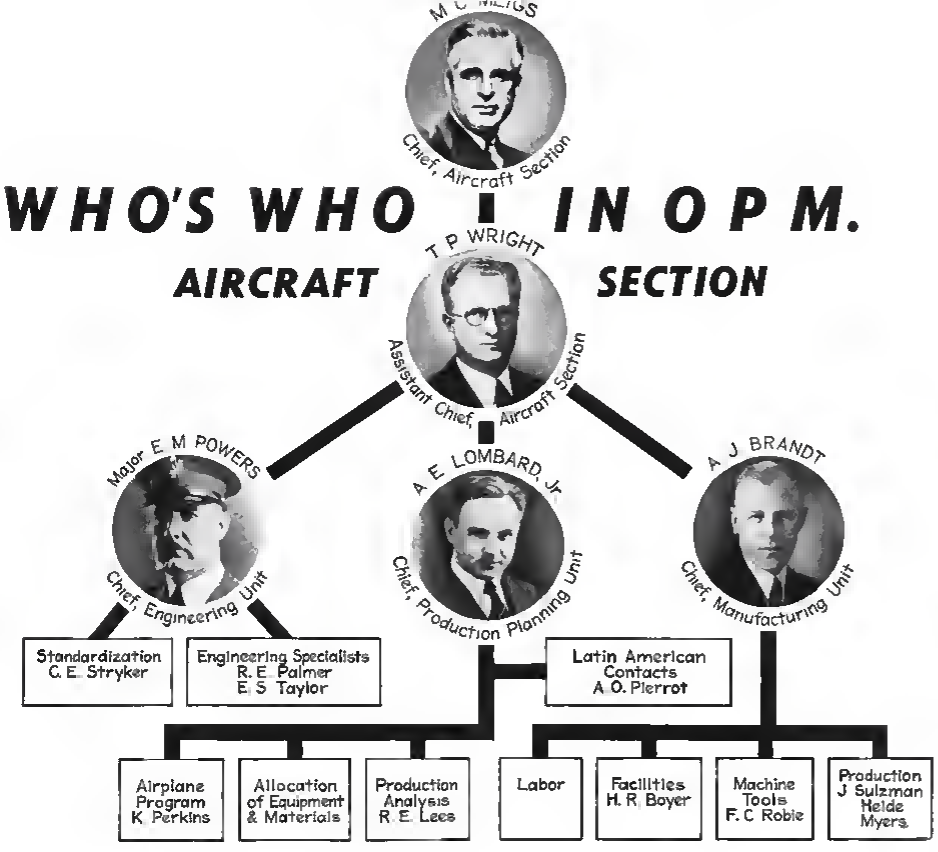
With the best will in the world and the most determined effort to be cautious it is impossible to do anything but insist on the definite superiority of British aeroplanes in comparison with those they have so far had to meet. The fighter's have a most striking ad-

(Turn to page 120)

Pilots of the RAF. Lads like these, backed up by excellent equipment, have rocked the Nazi air force back on its heels. German pilots are no match for the superior training and fighting strength of these British pilots.

WHO'S WHO IN O P M.

AIRCRAFT SECTION



TRANSFORMATION of the Defense Advisory Committee into the Office of Production Management is being rounded out as far as the Aircraft Section is concerned under the leadership of Merrill C Meigs A staff of highly qualified personnel has been attracted to Washington and has taken office space in the Social Securities Building, which probably will constitute a permanent headquarters for OPM. The Aircraft Section is essentially a "trouble-shooting" organization set up to foresee capacity problems and manipulate shortages in various phases of the program Details of its relationship to the Office of Production Management organization will be found on page 81 Herewith are presented a number of thumbnail sketches of key personnel

A publisher a private pilot with 1500 hours and a transport ticket, and an able organizer Merrill C Meigs has been at the forefront in varied fields

Born in Marshalltown, Iowa, he worked for the J I Case Co of Racine, Wis., both before and after he went to the University of Chicago, and as representative of the company sold and demonstrated tractors throughout the Middle West and in South America. It was during his connection with the Case Co that he organized the famous racing team headed by Louis Strang, and then went into advertising as an executive with Lord & Thomas In 1918 he became advertising director of the Chicago *American*, and in 1926 publisher of the Chicago *Herald-Examiner*, now the *Herald-American*

Associated with flying from the beginning of aviation in the U S, Mr Meigs was the first civilian to make a cross-country passenger flight and one of the first organizers of a commercial transportation company More recently he was a participant in the first passenger flight of the Clipper to London, and since 1927 Mr Meigs has been flying his own plane

If the needs of OPM's Aircraft Section had been foreseen 20 years ago, and one man assigned to spend two decades preparing for its direction, his background and experience could have been no more thorough than that of Theodore Paul Wright Many of his broad range of accomplishments are already known to readers of AVIATION and here we can only touch on the high spots During his attendance at M I T he enrolled in the Naval Reserve Flying Corps and was commissioned as lieutenant in 1920, later becoming an Inspector of Naval Aircraft, assigned to the Buffalo and Garden City plants of Curtiss Aeroplane & Motor Co, Inc. In October, 1921, he entered the organization as executive engineer and rose rapidly to chief engineer of the airplane division in 1925. Under his direction many famous military and commercial designs were developed and an extensive research organization set up. In 1931 the experimental laboratory at the Garden City plant was moved to Buffalo and combined with the research and production functions carried on under his direction. Three years later he was transferred to the New York office of the Curtiss Wright Corporation as director of engineering and chairman of the engineering policy and planning committee of the parent company

Mr Wright's production and engineering experience is not confined to this country, as he has travelled extensively in Europe and studied the methods used in England Germany, Italy, and France He has written many lectures and papers, including a series published in AVIATION, and has made important economic studies of air transport trends He has also done valuable work as an officer and director of aircraft standards activities of the Society of Automotive Engineers, and is a member of many aeronautical organizations.

Chief of Planning Unit, Dr. A. E. Lombard, Jr, received his degree of Ph D. at California Institute of Technology in 1939 Engaged for ten years (1929-39) as structural, aerodynamics, research, and consulting engineer for Curtiss-Wright Corp in Garden City, Buffalo and St Louis, he was in charge of design, construction and operation of the Buffalo plant's wind tunnel

At C I T. Dr Lombard has been assistant professor of aeronautics and mechanical engineering, and assistant director of wind tunnel research Author of several technical papers on airplane design and aerodynamics, his thesis was written on the subject of the occurrence of flutter in aircraft. He joined the old Defense Advisory Commission last summer and did pioneer work on the present program

To his present position as Chief of the Manufacturing Unit of Aircraft Production, Arthur J Brandt brings a wide engineering experience gained in this country and abroad

A Mid-Westerner, born in Walnut, Kansas, he is a graduate of the Case School of Applied Science, taking his B S in 1911 From 1915 to 1928 his engineering activities ranged from construction of chemical and powder plants for the duPont Co, to works manager of the Samson Tractor Div. of General Motors; resident manager of the Fisher Body Corp, and vice president in charge of operations, Pontiac Motor Co From 1928 to 1940, Mr Brandt has been engaged in his own consulting engineering business as president of A J. Brandt, Inc, Detroit, Mich, and is also president of The National Tool Co, Cleveland, O.

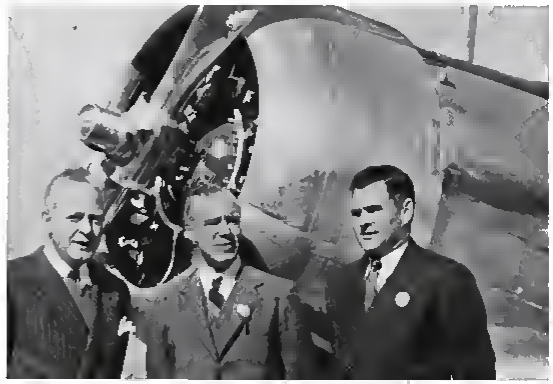
Among the more important jobs he has handled during the past 12 years have been the layout, tooling and starting in operation of the world's largest truck plant at Moscow, Russia; reorganization of production facilities of all U S Rubber Co plants, including the first successful development of the conveyor system for building tires, and reorganization of production activities and personnel of American Locomotive Co, Diesel Engine Div, Auburn, N Y.

In his present capacity in OPM, Mr. Brandt will assist all aircraft and aircraft engine and parts manufacturers in speeding up production for the U. S and Britain

Active in military aviation since 1917, when he enlisted in the Signal Corps U S A as a flying cadet, Maj Edward

(Turn to page 138)

Manufacturer Donald Douglas (center) discusses manufacturing problems with Charles Sorenson, production manager of Ford's River Rouge plant (left) and Edsel Ford (right).



"I am amazed at the remarkable progress being made here" said Assistant Secretary of War Robert P. Patterson (center), on his recent visit to North American's Inglewood, California, factory. The Secretary was the guest of President J. H. Kindelberger (left). Major Donald E. Stace (right) is Air Corps representative at North American.

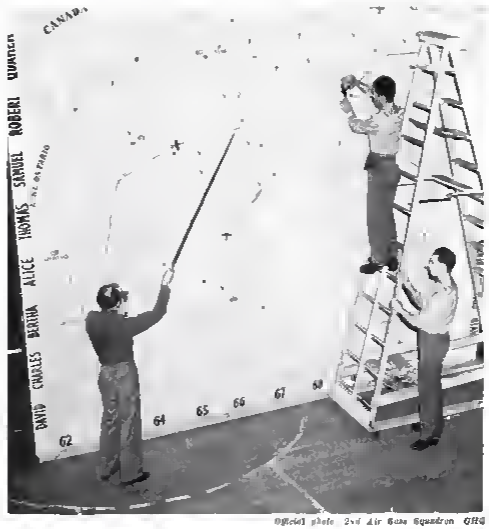
U. S. PREPARES ITS AIR DEFENSE

PROFITING from lessons learned in Europe, the Army's Air Defense Command has gained much valuable experience in recent months through its war games, in which "enemy" bombers try to get through to attack military and industrial objectives. Twice in the past six months these maneuvers have been held along the east coast last fall in upstate New York along the Canadian border, and in late January throughout part of New York and New England. Photographs on these pages represent these maneuvers

British experience has proven that when bombers may be expected over a large area it is necessary to use civilians as an auxiliary to trained military observers in spotting approaching aircraft Hence one of the prime purposes in these war games has been to test how effective a civilian warning net might be. With the help of the American Legion, thousands of private citizens have been coached to watch for airplanes, then rush to their telephones and flash the news to Air Defense Command headquarters In the most recent maneuvers 10,000 observers were at some 700 observation posts.

In some instances bombers got through to their objectives but more often the air defense warning net worked so smoothly that pursuits intercepted them and kept off the invaders

Map below was installed to show public how progress of invading bombers is charted. Squares are located by names at left and numbers at bottom



Official photo 2nd Air Base Squadron GHQ

When news of invading bombers reaches Mitchell Field, pilots make a dash for their P-40's.

Wide World

Maj Gen James E Chaney left, shows A. T. & T president Walter Gifford civilian observation posts

International News

Below: A message center at Watertown, N. Y. with enlisted men receiving flash messages relaying advice to mapping groups.

Official photo 2nd Air Base Squadron, GHQ

Location of approaching bombers is kept on a map Newest type map is many times larger than this one and is laid flat on the floor

Official photo 2nd Air Base Squadron GHQ

Ruby Arnold

Sleek P-40's above are from Mitchell Field and provided chief defense against invading bombers.

Left Anti-aircraft unit of 62nd Coast Artillery from Fort Totten, N. Y. strains its "ears" to detect oncoming bombers.

On facing page, anti-aircraft battery using a Sperry search light to watch for bombers.

"——with as trim and clean a fuselage nose as the snout of a high velocity bullet—" the Bell P-39 interceptor-pursuit in flight.

WHY A Rear Engine Installation

A new era of aircraft conception and design is forecast in this story of how an important step in aerodynamics was taken by Bell engineers in the design of the P-39 Airacobra

PART I

By Robert J. Woods

Chief Design Engineer
Bell Aircraft Corp

"PLAIN as the nose on your face" has long been an epigram of everyday usage, and for a long time the engine-bulged noses of most airplanes have been a very evident feature. The rather bloated, bumped and usually bescooped "snozzolas" of some airplanes that have been built have been not only extremely prominent to the eye, but were generally associated with poor aerodynamic efficiency at high speed due to the high drag resulting. In the parlance of the aviation industry these airplanes had 'built-in head winds"; "their noses were dirty"

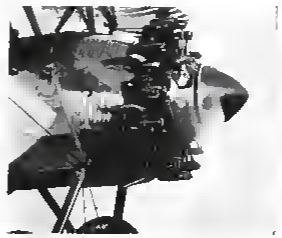
The bulging noses of most of the airplanes we have seen have bulged for good reason. The engine of an airplane is usually the largest single item of installed equipment. The requirement in most cases for the installation of engines of maximum possible power has obviously not permitted the selection of small-sized engines. The physical limitations of materials, mechanics and thermodynamics limit the possible arrangement of airplane engines in general to one or two formulas of design: the so-called "In-line" type and the circular or "Radial" type. Neither of these types of engines are very small when high horsepower output is required, and the radial types have generally been the worst offenders in size, due to their having the largest frontal areas. Airplane engines also generally require much auxiliary equipment which must be closely grouped with the engine. Such auxiliary equipment adds generally to the bulk of the engine installation and is usually the principal cause of the many scoops and bumps that are often associated with the cowling over an aircraft engine.

Bell Aircraft Corp., of Buffalo, N. Y., has developed a new and different kind of airplane, a military single-place fighter type with as trim and clean a fuselage nose as the snout of a high velocity bullet—the Bell P-39 interceptor pursuit now in production for the United States and British Air Services. The powerful 1150 horsepower Allison 12 cylinder in line liquid cooled engine has been swallowed into the true streamlines of the fuselage so thoroughly and completely that to an inexperienced eye the actual location of the engine may not be immediately discernible. The story of how this important step forward in the art and science of aircraft design was accomplished is told here in the hope that it will foretell a new era of conception and design in which the "dirty noses" will disappear from our aircraft in favor of the "clean" entry which permits achievement of many important improvements in utility and performance.

Less than two decades ago the sight of a completely uncowled engine in the nose of an airplane was not an uncommon sight. The exposed cylinders of the air cooled engines used to stick out into the airstream quite prominently, with little more cowling than a piece of tin wrapped around the crankcase, and the old Consolidated PT-1 primary trainer with its completely unclad water cooled "Hisso" was classic. The aerodynamic efficiency of these completely uncowled engines, we have since learned, was almost non-existent. A few scattered attempts had been made in the early days to produce smooth fuselage noses on racing airplanes, but the general use of a smooth entry or smooth cowling over the engine was not prevalent.

Almost simultaneously two improvements were proposed for cowling the exposed cylinders of radial air cooled engines. One, the so-called Townend Ring, developed in England, and the other the NACA cowling developed at the National Advisory Committee for Aeronautics Laboratories in America. Although much controversy existed at the time regarding the relative merits and limitations of the Townend Ring versus the NACA cowling, the Townend Ring finally turned out to be more or less of a stop-gap solution to the problem and the NACA cowl was generally adopted and used on all radial air cooled engines. The smooth NACA cowling, although rather bulbous and large, was quite an improvement as it brought with it, as a first reward, rather important increases in speed by reduction of drag. The benefits that followed in improved stability and control and finally, in spite of the early misgivings of the engine manufacturers, in improved cooling, were real advances in the science of aircraft design.

'The old Consolidated PT-1 primary trainer had litlin more cowling than a piece of tin wrapped around the crankcase.'



A few scattered attempts had been made in the early days to produce smooth fuselage noses on airplanes. This shows one with cylinders projected into the slipstream.

'The so-called Townsend Ring finally turned out to be more or less of a stop-gap solution to the cowling problem."

'Although rather bulbous and large, the smooth NACA cowling has made a substantial improvement."

Along about the same time a definite change took place in the design of the noses of airplanes carrying liquid cooled engines. The usual flat radiator which had been installed ahead of the engine directly behind the propeller, was now placed further aft under the engine on the bottom of the fuselage in a serious attempt to provide a real streamlined shape to the nose cowling of the airplane. This arrangement was used on several Army Air Corps airplanes using Curtiss D-12 and Conqueror engines.

When the gains made in improved performance, stability and control and cooling function due to these changes had been established the way was shown for research and development to determining the optimum arrangement in fuselage nose designs. The aircraft designers had become "nose" conscious and no time was lost in determining the ultimate in refinement. The ultimate turned out to be our old friend the pointed nose of a high speed bullet.

The next phase of the development of nose shape was in providing cowlings for radial air-cooled engines of greatly increased horsepower. The original NACA cowling designed for the J-5 and P&W Wasp engines was increased considerably in size to enclose the more powerful engines and began to develop miscellaneous appendages in the form of scoops for taking in cooling air, cowling flaps at the exit slots and various and sundry other complications. Several in line type air cooled engines appeared on the scene, with slick looking cowlings that were quite efficient. But, these engines were almost without exception limited to relatively low horsepowers.

The liquid cooled in line engines did not appreciably increase in size with increased horsepower, but on the other hand were equipped with reduction gears for the propeller and so arranged as to provide a much smoother symmetrical streamlined nose. Propeller spinners were generally used, and the radiators were moved still further aft to a position under or aft of the wings. The clean streamline bullet nose was beginning to come into the picture, although the number of scoops, bumps, dents, machine gun blast tubes, exhaust manifolds, etc., that the practical design artists and standardization experts managed to get stuck on the outside were to say the least detrimental.

However new problems began to come into the picture when, with the increase in horsepower of the engines, the weight became a greater proportion of the total weight of the airplane and adversely affected the airplane balance. The engines had to be pushed back toward the wing so that the noses of the single engined airplanes became stubbier and began to resemble streamlined nail kegs. Also, the necessity for controllable pitch and automatic type propellers with their relatively large increment of weight augmented the balance problem.

To add to all of these problems on single-engined military type aircraft, the long standing requirement for two medium-size machine guns synchronized

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It was on the "Airacuda" that Bell first made a practical application of an extension drive installation

Seaplane or Landplane for Transoceanic Service

The author believes that a properly designed flying boat of a size of 50-100 ton gross weight, besides greater safety and convenience of operation, would have an equal cruising speed, appreciably better payload or longer range at that speed, compared with a land plane of the same gross weight, power plant and volumetric capacity.

By Michael E. Gluhareff,
Chief of Design, Vought-Sikorsky Div. United Aircraft Corp.

The Vought-Sikorsky VS-44A, one of the latest designed flying boats.

THE time is now past when doubts exist regarding the practicability of commercial travel by air across the oceans. The general public and airline operators already know that this method of transportation over the vast stretches of water is safe, most convenient and economical. A large demand for such transportation is inevitable. Present conditions already clearly indicate the desirability of planes, of somewhat larger capacity than those in service, and which would be capable of crossing the Atlantic, non-stop.

Although flying boats have been used up to the present for this service, there are some arguments concerning the desirability of using land planes instead of flying boats in the future. Numerous papers have been presented and articles written on the subject. Some of them, in the opinion of the author, presented satisfactory conclusions. There are proposals for various radical designs which are not practical now or for the near future due to the lack of engineering and service information to prove the merits claimed.

The presence of discussions and different opinions reveal a great interest in this important subject and are very beneficial, especially now and in connection with the national defense of our country, where long-range airplanes are an absolute necessity, particularly flying boats, which are independent of long runways and the resultant large flying fields.

It is the object of this article to analyze objectively the reasons why a flying boat is a more practical and advantageous type of aircraft than a land plane for long-distance over-water service.

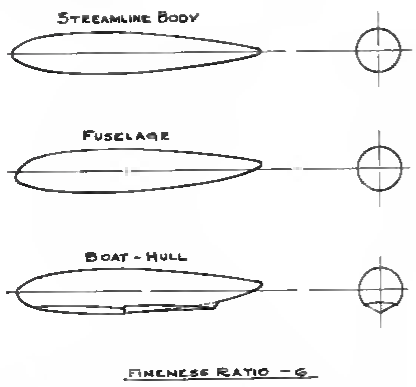

Fig. 2. Form of the fuselage and boat-hull in vicinity of 100 ton gross weight airplane.

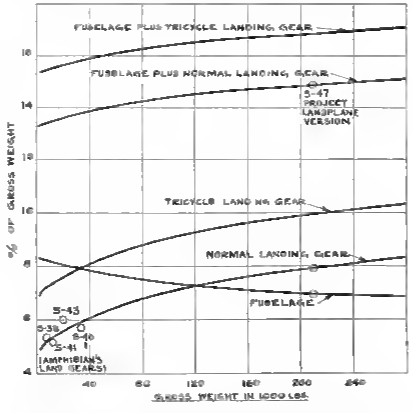

Fig. 3. Trend of weights of fuselage and retractable landing gear for airplanes. Points are from Vought-Sikorsky designs.

General Specification

Obviously, the airplanes we have today cannot be the ultimate achievement. Continued improvement in design, power plant and material or an entirely new type of aircraft may alter the situation tomorrow. However, in the light of present knowledge, let us consider only the airplanes which are most likely to be built now for coming non-stop transoceanic service — airplanes of nearly the conventional design of today.

It is proper to mention here that from a purely aerodynamic standpoint, the flying wing type is an excellent solution for the long range machine but for passenger service it is impractical because there is not sufficient room inside. The study of a 100-ton flying wing as a trans-Atlantic non-stop passenger carrier revealed that there was barely enough useful space to accommodate power plant and fuel if it is to be an efficient design.

Michael Gluhareff

Coming to present and expected demands for transoceanic air service it seems reasonable to assume that ships of 50–100 ton gross weight will be needed to carry the payload. Safety dictates the necessity of multi-engined craft with not less than four engines, capable of taking off under its own power and crossing the ocean non-stop. It hardly seems necessary at the present time to ask for speeds, throughout the entire range, in excess of 200 m p h at altitudes of 8,000–10,000 ft. Such ships should have ample room for the accommodation of passengers, mail and express. National defense suggests that these airplanes be capable of transformation into patrol bombers or troop-carriers.

For the sake of comparison of the two types of aircraft likely to be designed for such service—landplane and flying boat—let us consider airplanes that are equal in gross weight, power plant, cruising speed, cruising altitude, payload and volumetric capacity. The value of the airplane type may then be measured by its range.

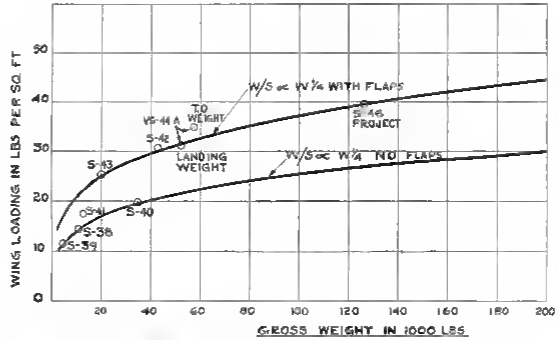

Fig. 1. Wing Loading plotted against Gross Weight. Points taken from flying boats designed at the Vought-Sikorsky Division, United Aircraft Corporation.

Discussion

The author and the organization with which he is connected, have been working on and studying long-range airplanes of nearly all types for military and commercial use for many years. The practical experience in design and construction of large flying boats by this company indicates that, when everything is taken into consideration, the all-around practical, long range transoceanic airplane is likely to be of the flying boat type.

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Eliminating Propeller Failures

In 1932 there were 41 propeller failures in flight. Last year there was none. Here is the dramatic story of the research that brought this improvement.

By Erle Martin

Hamilton Standard Propeller Division
United Aircraft Corp

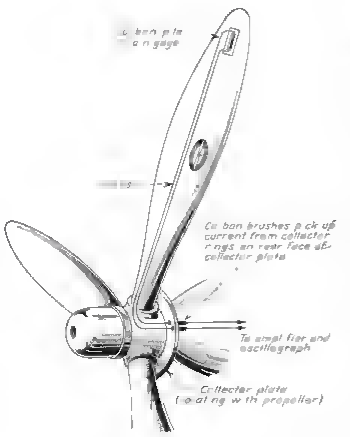


Fig 1 Measuring vibration stresses in flight As explained in the text, electric impulses from the point of measurement on the blade are transmitted to the recording device in the airplane's cabin. Fine wires from the strain gage on the blade are cemented along the blade and led off at the hub to a circular plate behind the propeller. This plate rotates with the propeller, and current is picked up from collector rings on its rear face by means of brushes and carried by wires to the recording device.

PROPELLER FAILURES IN FLIGHT

Year	No. of Failures
1931	37
1932	41
1933	34
1934	13
1935	8
1936	11
1937	15
1938	23
1939	6
1940	0

THE most important propeller problem since the earliest days of aviation has been the problem of safety. While any failure of the airplane structure is likely to be a serious matter, a propeller failure is usually disastrous. The safety of propellers has been therefore a matter of the utmost concern to the entire aeronautical industry.

As early as 1916 when propellers were constructed entirely of wood, the problem of vibratory stress was the primary cause of propeller failures. Since the propeller is a relatively simple structure, the steady stresses can be calculated by well-known methods. The vibratory stresses, however, have never been subject to analysis or calculation, and have been the cause of practically all propeller failures ever since the early difficulties experienced with wooden propellers.

The advent of the metal propeller greatly increased the problem due to the fact that the fatigue strength of metals used for propeller construction is from 25 percent to 50 percent of the ultimate strength of the material, as compared to 75 percent to 100 percent in the case of wood.

Attempts were made to assure the safety of propellers by overload tests on electric motor whirling rigs at powers up to three times the engine power for which the propeller was intended, and by an additional test of 100 hr at maximum power on the engine after completion of the whirl test. While these tests were very helpful in discovering the propellers' serious inherent weaknesses, they were found to be quite inadequate as a complete solution. The only satisfactory way of proving the safety of any given propeller-engine-airplane combination was to conduct actual service tests for several thousands of hours on a half-dozen or more propellers, a procedure which might not be conducive to the safety of crew or passengers during the tests.

When a failure took place during this service test, a correction was made and the service test repeated to see if the solution tried proved to be a proper one. This method of ascertaining the safety factor of propellers often required one to two years' time. This situation was of course intolerable and at least some ten years ago Hamilton Standard recognized that a means must be found for measuring the vibratory stresses of propellers in use so that the actual operating stress level in the propeller could be determined.

Accordingly Hamilton Standard embarked on an exhaustive program of research on these problems which has extended over a ten-year period and during which time various methods of solving them were carefully investigated. Out of these investigations and study evolved the method of measuring vibration stresses herein described. This technique has been developed to such an extent that a complete survey of propeller blade tip and shank stresses throughout the entire operating speed range may be made within several hours of operating time. A complete survey of the airplane engine-propeller combination can be made in flight. The records obtained by this test method, in combination with the calculated steady propeller stresses, give a complete picture of the conditions under which the propeller is operating and permit the engineer to predict the actual operating factor of safety within limits of error heretofore impossible. The information obtained in this way in a few hours of test time is undoubtedly of greater value in predicting and insuring propeller safety than was previously possible, even after the successful whirl test, engine test and service test.

Description of Method

Over the period of years from the adoption of metal propellers up to 1936, there occurred occasional failures of the propeller hubs and blades which could only be explained by a repeated stressing (loading) and unstressing of the propeller material. It was well known that if a stress cycle of sufficient magnitude were repeated sufficiently often a failure could be produced at a stress below the ultimate strength of the material. It was also known that if the stress were reduced below a certain limit, no failure would result no matter how often the stress were repeated.

Bending vibrations of the propeller blades excited by the power impulses from the engine were suspected as the source of the required often-repeated stresses which resulted in these failures. Very approximate estimates could be made of the speed at which these blade vibrations might become critical, but until a quantitative picture of the importance of these critical stresses could be obtained, the prediction of propeller safety was largely a matter of intuition backed by qualitative experience.

In attempting to measure propeller vibratory stresses, certain fundamental and practical problems were immediately manifest. The centrifugal force at a propeller tip at take-off speed may easily reach a value of 8,000 times the weight of a body placed there. Light weight of the indicating instrument was, therefore, important. A continuous response which could be observed away from the propeller at all times was almost a recessity, so that an electrical instrument was apparently required. If the measurements were to be made on service installations of propellers, an attaching means which did not mar or damage the propeller was essential. And, perhaps, most important of all, the stress pickup must be capable of being precalibrated and rechecked at the completion of the test.

The method which was finally evolved by Hamilton Standard is relatively simple yet provides a complete and accurate record of the stresses involved. It depends upon the phenomenon that certain materials increase and decrease

(*Turn to page 118*)

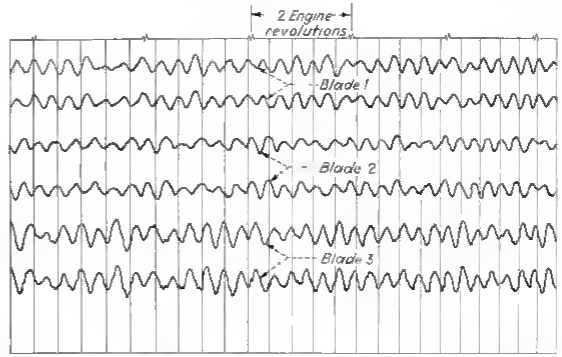


Fig. 2. Sample oscillogram showing stresses at six different points on a three-bladed propeller.

Fig. 3. Test equipment has been refined to such a point that simultaneous records of stress conditions at twelve points on the propeller can be made. This shows apparatus in the test house.

SUMMARY

This is a brief discussion of the work on vibration problems done by the Hamilton Standard Propellers Division of United Aircraft. *The outstanding results of the study are as follows:*

1 It has definitely and substantially improved the safety of aircraft by reducing propeller failures in flight to the vanishing point.

2. It has improved the performance of aircraft by permitting drastic reduction in specific weights of propellers, which were rapidly reaching critical proportions.

3. It has greatly reduced the development time required on new propeller designs by substituting very brief laboratory tests for long periods of service testing previously required.

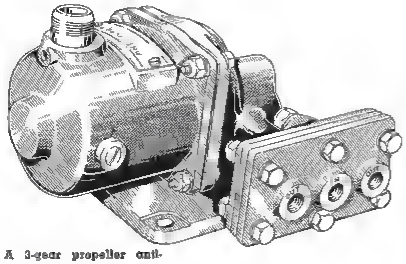
4 It has contributed materially to improved design of other airplane parts, particularly engines, in determining various types of engine vibration and the proper corrective measures to be applied.

As indications of the extent to which the value of this achievement has been demonstrated the following facts speak for themselves:

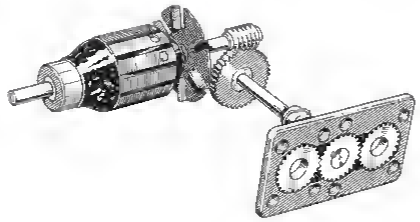
1 The Materiel Division of the United States Army Air Corps, the Bureau of Aeronautics of the United States Navy, and the Civil Aeronautics Board now require all types of propellers to be subjected to these vibration stress tests prior to their final approval for service use.

2. Every modern airplane-engine-propeller combination now in service on airlines in the United States has been subjected to these tests.

3 In spite of the tremendous growth of both commercial and military aviation the number of propeller failures has rapidly declined since this technique has been in use and during the twelve months of 1940 for the first time in history, there were no propeller failures.



A 3-gear propeller anti-icer pump with entirely enclosed explosion-proof motor and an explosion-proof AN quick disconnect plug



The moving parts used in the anti-icer pump shown at left.

Carburetor and Propeller ANTI-ICERS

Reliable pumps that operate under all conditions are a "must" for any anti-icing system

By David Gregg *Chief Research Engineer, Eclipse Aviation*

WITH the successful solution of wing icing by means of rubber deicers, the problems of propeller and carburetor ice remained. Slinger rings and anti-icer pumps have largely eliminated propeller icing; heat and alcohol injection are solving the carburetor icing problem. We are all more or less familiar with the methods of application, and interest now centers on the specific items of equipment involved, and the factors governing their design.

Consider propeller icing. We know that a mixture of alcohol-glycerine fed to the propeller by a slinger ring spreads over the surface of the propeller blades in a more or less effective pattern, reduces the adhesion of the ice as it forms and centrifugal force does the rest. Slinger rings are more or less standardized. The liquid used has been standardized. The amount of liquid required falls within certain definite limits.

The last remaining variable is the anti-icer pump that delivers liquid to the slinger ring. There is every breed and variety of pump on the market; single outlet, double outlet, four outlet, diaphragm type, gear type, even converted windshield wipers have been used.

Anti-Icer Installation for 4-Engine Airplanes

Type of Pump	No. Req'd	Location	No. Tanks	Location	Type of Flowmeter	No. Req'd	Feet of Tubing Req'd
2 section	2	Eng. Nacelle	2	Eng. Nacelle	Electric	2*	40
4 section	1	Eng. Nacelle	1	Eng. Nacelle	Electric	1	100
4 section	1	Fuselage	1	Fuselage	Electric	1	100
Single	1	Fuselage	1	Fuselage	Liquid	4	140
Single	1	Eng. Nacelle	1	Eng. Nacelle	Liquid	4	166

* or 1 electric flowmeter and two-way switch

Anti-Icer Installation for 2-Engine Airplanes

2 section	1	Eng. Nacelle	1	Eng. Nacelle	Electric	1	40
2 section	1	Fuselage	1	Fuselage	Electric	1	40
Single	1	Fuselage	1	Fuselage	Liquid	2	70
Single	1	Eng. Nacelle	1	Eng. Nacelle	Liquid	2	85

What is the best type of anti-icer pump and why? That is a definite question and an equally definite answer is available. Let us consider the facts. Ice forms on the propeller under many different atmospheric conditions and there are many different types of ice formation. The pilot cannot read an instrument and say, "I need 2 qt. of liquid per hour per propeller" or "I need 4 qt. . . ." He still judges the amount of liquid required by feel and by ear.

When he first uses the anti-icer pump he turns to a high rate of flow until the initial ice formation is removed, then gradually reduces the rate, keeping the flow just above the point where the ice slushes uniformly against the side of the fuselage and engine vibration has been reduced. The flow that accomplishes these results differs for different ice conditions. As the pilot judges the amount of liquid required by the feel or sound of ice removal from one propeller, it is essential that all other propellers receive approximately the same amount of liquid in order to remove effectively their ice. The pilot must have some definite way of knowing that this result is being accomplished. That is the first requirement.

The second requirement follows. There must be some effective control by which the amount of liquid supplied can be varied. Several years of airline operation and accurate measurement of the amount of liquid used under varying weather conditions indicate maximum limits of from 2 to 8 qt. per hour per propeller, the higher flow being used when the anti-icer pump is first turned on to remove accumulated ice. An average of approximately 3 qt. per hour per propeller is used under ordinary ice conditions.

The third requirement is based on the characteristics of the liquid used. We know that an alcohol-glycerine solution may evaporate in the pump and lines when they remain unused, leaving behind a sticky glycerine deposit that collects in low spots in the system and blocks the outlet lines, or gums the operating parts of the pump. When the anti-icer pump is placed in operation it must have sufficient power to overcome initial friction of the gummed parts and develop enough pressure to force any deposit of glycerine from the lines. It must be capable of instant starting and continuous operation at temperatures normally below the freezing point. It is, therefore, essential that the maximum power available to drive an anti-icer pump be largely in excess of the normal operating requirements otherwise the pump may not function.

As alcohol is anhydrous, the liquid in the tank will gradually absorb water and the resulting mixture is far more corrosive than the fresh solution. The materials used in the anti-icer pump must accordingly be selected to prevent this corrosion.

These then are the four basic requirements of an anti-icer pump:

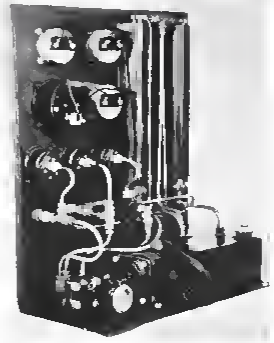
1. Uniform distribution of flow.
2. Control of rate of flow.
3. Adequate reserve power and pressure.
4. Freedom from corrosion.

Uniform flow distribution to several propellers can be secured by a single outlet pump and means of accurately dividing this flow, or by a multiple pump with a separate outlet for each propeller. Various combinations and arrangements are possible. Consider the actual installation in an airplane and the equipment involved as shown in the following table. Here the length of tubing required has been based on the estimated distance from the pilot's cockpit to the center of fuselage at the wing spar, the distance from this point to each of the engine nacelles, and the distance from the base of the engine nacelles to the slinger ring. These estimated distances are probably less than occur in actual practice due to bends in the tubing, so that the estimated tube length is, if anything, too short.

Several facts are apparent from a study of this chart. First it is obvious that the use of liquid flowmeters, such as a float in a tapered glass tube, increases the required length of tubing from two to six times, while an electric flowmeter has no effect on the tube length. Next, it is interesting to note that the estimated length of tubing for anti-icer installation in a 4-engine airplane is exactly the same as that for 2-engine airplanes, when two, two-outlet, anti-icer pumps are used, and that this arrangement gives the minimum tube length. Assuming then that a two-outlet pump provides the most desirable production unit and affords the simplest service installation, what type of pump is best? As far as the drive goes, an electric motor is clearly indicated and its choice has been practically universal.

Now for the pump itself. The original propeller anti-icer pump resulted from the collaboration of several groups investigating propeller ice removal. Information at that time favored a dual diaphragm type of pump. Several thousand of these units have been used and have given good service. At first, gumming of the valves caused some difficulty, but a new type of flexible valve largely eliminated this trouble. Accumulated research and service experience led to the development of the gear type anti-icer pump with no valves to gum or stick, and few moving parts. For a two outlet gear pump, two arrangements are possible, two sets of two-gear pumps driven by a single motor, or a single three-gear pump. The latter type eliminates one gear and one set of tolerances as well as several bearings—so is inherently more accurate than the double pump. As the required output is low, the gears and housing must be made to very close limits if the pump is to provide uniform flow from two outlets under widely varying pressure characteristics. Laboratory and service testing point to maximum total clearances, between the sides of the gears and the housing, of .0003-in. to provide proper flow. Such clearances require tolerances beyond the range of ordinary production methods, and involve adequate tooling and thorough inspection.

Portable test stand for anti-icer pumps. It gives all necessary readings for a complete test



Rear view of test stand shown above.

Such a pump is illustrated herewith, both assembled and disassembled. Parts and weight have been reduced to a minimum. The unit is completely explosion proof, and includes an explosion-proof AN quick-disconnect plug. The dry prime of this pump is equal to a lift of 10 to 15 ft. of alcohol-glycerine solution, and once the gear teeth are wet, a vacuum of approximately 28 in. of mercury can be maintained. The discharge pressure is equal to the resistance through the installed tubing and is normally 5 to 10 lb. per sq. in., but the pump is capable of building pressures of from 300–600 lb. per sq. in. if necessary, to remove congealed slugs of glycerine from the lines. Though the manufacturing processes must be closely controlled in a pump of this type, service replacements are almost entirely eliminated. Aside from changing the motor brushes or possibly an oil seal, there are no parts that should require repair or adjustment in a service life beyond that of the airplane in which the unit is to be installed. The uniform distribution of flow possible with a pump of the type described here is shown by the output curve, with one outlet at zero pounds back pressure, the other at 15 lb. per sq. in. back pressure.

With distribution of flow taken care of by proper design and manufacturing methods, the rate of flow can be accur-

(Turn to page 130)

NINTH ANNUAL MEETING OF THE

Institute of the Aeronautical Sciences

Each year the value of the annual meeting of the Institute of the Aeronautical Sciences is increased. It represents a cross-section of the industry's technical developments—a few of the important papers are abstracted in the following.

ONCE again the annual meeting of the Institute of the Aeronautical Sciences has been held and once again there were presented papers that give a representative view of what research and technical work is being carried on throughout the industry. Preceded by the Honors Night Dinner, on Jan 28, the meetings lasted for three days, with sessions in the morning, afternoon and one in the evening.

The Honors Night dinner had more "brass-hats" of the industry per square inch than have ever before been collected in one place. Frank W. Caldwell, able Director of Research for the United Aircraft Corp., was inaugurated as president of the Institute for this coming year, succeeding Major James H. Doolittle. Interesting highlights were the talks by Major Gardner on this last year's contributions to the I. Ae. S. and by Griffith Brewer, distinguished president of The Royal Aeronautical Society, who recounted anecdotes of early aviation.

With this as a good start the meetings got under way with some sixty-odd technical papers presented. Although space does not permit a review of all of the papers given, the following abstracts give a cross section of what important subjects were covered.

Air-Cooled vs. Liquid-Cooled Aircraft

By John G. Lee
United Aircraft Corp.

There are many reasons for choosing an air-cooled or a liquid-cooled power plant. They may be technical, economic, or practical. They may depend upon the equipment of certain factories, or the collective experience of a group of engineers, or the previous equipment of an air force. The present paper is confined to the technical reasons. The basic drag of a streamline object is first considered. The curve of drag coefficient vs. fineness ratio serves as a reminder that practically speaking, drag is not caused by frontal area alone, but is largely caused by skin friction. In a perfect fluid, a streamline object has no drag at all. It is clear that when we increase the diameter of a fuselage to take a larger engine the increased drag is due, not to the increase of frontal area, but to the increase of surface area, other things being equal.

It is interesting to pursue the subject of frontal area and fineness ratio a little further. Of course, if the length of the fuselage or nacelle is already determined by other factors, increasing its diameter does increase its drag. In the case of the drag of an engine nacelle, the situation is complicated by the presence of the wing behind it. A reasonable order prevails. The smaller the nacelle relative to the wing, the lower the drag coefficient.


JOHN G. LEE

A word about the 'submerged" engines may be in order at this point. During the past few years wings have been getting thinner for planes of a given gross weight, and it now seems almost impossible to design an engine which may be wholly housed within a wing and which will have sufficient power to be attractive. If the power of these "flat" engines is not really large, higher performance can be obtained in an airplane using larger engines of orthodox type.

Summarizing the material presented so far, it is apparent that increasing the diameter of a fuselage or nacelle of given length results in an increase in drag, due principally to the increased skin friction area and to the interference effects upon the wing. This increase in drag is very much smaller than the increase in area, but is sufficient to count in favor of a compact liquid-cooled engine.

Meredith (F. W. Meredith "Cooling of Aircraft Engines" R&M 1683, August, 1935) and others have shown that if air is admitted to a passage at high speed, expanded through a diffuser to a condition of low velocity and high pressure, and then heated, the heat energy imparted to it may be recovered as thrust, if the air is discharged rearwardly through a nozzle or gill. This is the familiar "ducted" radiator of the liquid-cooled engine. It is also the air-cooled engine itself.

The only difference between the radiator and the air-cooled engine is that the radiator can be fitted with duct work without modification of the remainder of the cowl and hence engineers found this a relatively simple change to make. The important point is not whether the air cooled or the liquid-cooled engine has the lower cooling drag, but that the cooling drag of both is being rapidly reduced, and may ultimately become zero.

Any system of heat energy recovery from the engine requires heat transfer from the engine, ultimately, to the cooling air. Heat transfer to be efficient requires that the heat be available at the highest possible temperature. Hence, the high temperature, air-cooled cylinders are intrinsically more effective for heat energy recovery than the lower temperature coolant radiators. It should be noted also that only a minimum amount of cooling air should be wasted. This is where the "ducted" radiator has had an advantage in the past. The baffles of the air-cooled engine have not been good enough. Improvement in the internal cowling and baffling of air-cooled engines is underway. . . .


C. BEDELL MONRO


IGOR I. SIKORSKY

Throughout the remainder of this paper the cooling power for both air-cooled and liquid-cooled engines has been arbitrarily taken as 3 percent of the engine take-off rating. This value represents a conservative average from Pratt & Whitney two-row radials.

In any discussion of air-cooled and liquid-cooled engines, the question of the relative fuel consumption always comes up. It is recognized by all that the fuel consumption under full throttle conditions of the air-cooled engine is materially poorer than for the liquid-cooled engine. However, no engine, whether military or commercial, flies at wide open throttle for more than a very small fraction of its total time. Even the pursuit plane must spend the majority of its time looking for its enemy, or getting from its base to the probable scene of operations. The significant fuel consumption, then, is the cruising fuel consumption. In studying the comparative weights of air-cooled and liquid-cooled installations, the actual weights of a considerable group of engines and their installations were investigated. This resulted in a mass of data, much of it confidential, but in all events too extensive to be presented in this paper. . . .


T. PARKER VAN ZANDT

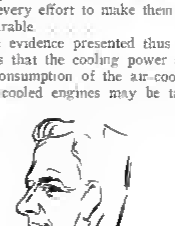
Whenever possible, actual weight values were used. It will be seen that some of the weight values varied over rather wide limits. The liquid-cooled engine weights, for instance, have a range of about 15 percent. This is because some engines included two-stage gear-driven superchargers while others relied upon turbo installations. In all cases, the individual weights were picked with due consideration and with every effort to make them strictly comparable. . . .


C. FAYETTE TAYLOR

The evidence presented thus far indicates that the cooling power and the fuel consumption of the air-cooled and liquid-cooled engines may be taken as substantially equal, but that the liquid-cooled installation has a certain advantage in drag and the air-cooled has a corresponding advantage in weight.

Using the data presented in the first part of this paper, certain groups of airplanes have been postulated and performance of air-cooled and liquid-cooled engines compared in each group. Certain of the engines are now in production, others are modifications of present engines, still others are only on paper.

We are accustomed to comparing airplanes on the basis of equal power and pay little attention to the fact that the liquid-cooled airplane, being heavier, is also the larger. We are primarily concerned not with the power of the airplane but with its performance, its cost, and the difficulty of building it.


FRANK W. CALDWELL


T. P. WILSON

We must include in that performance not only its high speed, but its climbing, landing and maneuvering ability.

We have not discussed serviceability, vulnerability, or engine cost. These are difficult qualities to handle quantitatively. A very good qualitative case can be made for the superiority of the air-cooled engine as regards serviceability and vulnerability. A bullet through the cooling fins or the baffles, for instance, will not stop an engine.

In this study it has been clearly brought out that, on the basis of equal weight, equal cleanness, and equal maneuvering characteristics, the air-cooled installation can equal the speed of the liquid-cooled, and surpass it in takeoff, climb, and ceiling. When range and weight-carrying ability are the primary consideration, the air-cooled has every advantage.

Propeller Design Problems of High-Speed Airplanes

By H. B. Dickinson
Lockheed Aircraft Corp.

THE problem of propeller design for high speed airplanes is the familiar one of extrapolating conflicting experimental data by means of inadequate theory. Airplanes have actually flown at speeds in excess of 400 m.p.h. and are being designed for higher speeds, and yet, to the author's knowledge, there is available not a single reliable test on a propeller at forward speeds of this magnitude. Therefore, the only recourse is to the calculation of

(*Turn to page* 132)

Applying Automotive Methods to Aircraft Production

Part II of an article describing what can be accomplished in planning projects and processes and the various elements necessary in achieving high industrial efficiency

By Don R. Berlin

Dir. of Military Engineering
Curtiss Aeroplane Division
and

Peter F. Rossmann

Research and Development Engineer,
Curtiss-Wright Corporation

PART I of this article, printed in the January, 1941, issue of AVIATION (p. 42), discussed mass production and suggested four requisites by which such methods could be accomplished: Product Engineering, Tool Engineering, Cost Analysis and Production Control.

In the concluding part there is offered the final three of these requisites to mass production in the aircraft industry.

Tool Engineering is greatly influenced by quantity and the basic design of the part. Properly planned and executed tooling contributes much toward the fulfilment of the mass production principle particularly

(A) Properly planned operation sequences
(B) Simple fool-proof jig and fixture design
(C) Gaging and locating points common to mating parts
(D) Non-fatiguing work heights and positions
(E) Reasonable application of time and motion studies
(F) Providing adequate inspection tools

The advantages and necessity of proper tooling cannot be over emphasized since the manufacture of interchangeable parts is the indispensable requisite precedent to mass production[2]. Therefore, in the production of increased quantities of aircraft, it is insufficient to merely expand proportionally the existent manufacturing facilities[3]. Better tooling acquires added significance since the product, as influenced by mass demand, must be produced more quickly and more economically. In this regard, advantages can be derived by encouraging increased respect for the automobile industry's attitude and dependence on effective tooling.

The inspection item although limited in its application (by quantity requirements) is of more importance than is generally conceded, but it is one of the most essential factors in controlling variations in the product. Inspection expedites production, witness for example, the extensive and ingenious automobile inspection tools. Therefore, it is imperative that provision should be made in the airplane tooling budget for inspection equipment. Good inspection tools inspire greater confidence in inspection results.

The third, "Accurate Cost Analysis and Regulation" is more than keeping books to record expenditures. The automobile industry is cost conscious and the modern car would be impossible without this consideration. Accurate estimates are necessary for reliable cost predictions and there is sufficient precedent and cataloging of aircraft manufacturing operation data to be of material assistance in compiling useful cost estimates. In fact, competition in the aircraft industry should give the necessary impetus to this phase of management. Cost regulation is the applied art of intercepting costs before the money is expended[4]. All costs should be challenged and justified, otherwise there can be no confidence in the operation of the expense budget. Time studies may be considered part of the analysis. More can be said on this subject of costs. However, there are authoritative publications indicating useful cost data which can be consulted in great detail.

The fourth, "Production Control" involves principally scheduling and material handling. The former requires accurate data on equipment and man power capacities so that an orderly flow of production can be maintained with the minimum of congestion due to holdups, changes, shortages etc. This control in automobile manufacture is the nerve center of production and the clock-like precision with which cars are produced is significant evidence of its effectiveness. Another element of such control that has had practically no recognition in the aircraft industry is the application of economical lot size (the economical cycle) or as it is more generally known the most economical number of parts to make in a setup. Heretofore, there has been limited opportunity to apply this science in aircraft but now circumstances are much more favorable to its adaptation.

Material handling can be regarded as part of production control and it is a very much neglected phase of manufacturing. Its function is more than regulating and moving material through the plant. In fact, an efficient plant layout is planned on the basis of proper routing of material between the process stations, assembly departments, storage depots, etc. Conveyors are a means of material handling and planned layout studies prescribe them when circumstances justify their use. Providing adequate supplies of material at the various process stations and the maintenance of shortage lists by stock chasers is also material handling.

Finally, there is the problem of designing the experimental airplane. This has always been a moot point, there being conflicting opinions as to the best solution of the problem. In the automobile industry there are different influences with regard to sales, customer's desires and requirements, trend of the art, etc. Furthermore, there is this important difference; the automobile industry flourishes under more advantageous conditions because that type of product can be slanted toward a sales active production. In addition, the experimental models will finally go into

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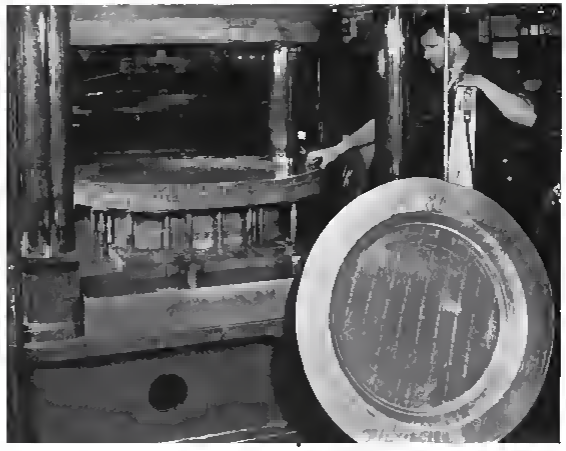
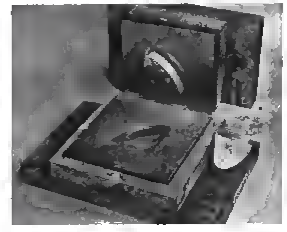


Showing the trend to steel-faced wooden draw dies. Wood used is maple and the facing is chrome molybdenum or carbon steel plate. These draw dies do not bottom on large parts but merely stretch the material over the punch. By virtue of the draw beads material achieves proper shape.



The trend is to fewer gas welding operations. Originally hammering over a zinc or wood form required about 20 minutes of labor with a tool investment of 5 dollars. On the steel-faced draw die about one per minute can be produced on a tool investment of $35.

Seam welding of exhaust stacks has reduced to a minimum the unpredictable factors in the welding of such parts. Gas welding is difficult to predict and represents quite a factor insofar as skill is concerned.

The trend is to fewer gas welding operations, particularly on junction boxes in which die castings have been substituted. A superior product is obtained, also a more predictable rate of production.

ICE-FREE CARBURETORS
FOR LIGHTPLANES

Here is one very practical solution to a problem that is often serious for lightplane operators

By L. V. Kimball
Mason Laboratories
New Haven Conn

DURING the last two years there has been a great increase in civilian flying, much of which is done in Class 1 and small Class 2 airplanes. Although carburetor heat has been available on practically all of these planes there have still been many complaints about carburetor ice or about symptoms which could be readily diagnosed as carburetor ice.

Symptoms

Many new pilots are as yet unfamiliar with the symptoms of carburetor ice, and, for this reason, it seems proper to explain them. The ice is usually formed in the carburetor at a fairly slow rate, depending on the outside air conditions, and is characterized by a drop in power or falling off of r p m. Sometimes this is accompanied by a roughness of the motor caused by ice around the venturi of the carburetor which makes the mixture very rich.

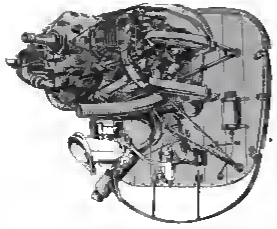
Where sufficient carburetor heat is available for take off and cruising conditions the carburetor may only ice up on the approach before landing in which case the pilot finds that on opening the throttle the engine either stalls or has practically no power. This is embarrassing if it is found necessary to go around again or use the throttle to correct under shooting the field.

Cause

Most of the smaller ships are equipped with carburetors which are subject to ice formed by refrigeration. This ice is formed from moisture removed from the air by the latent heat of vaporization of the gasoline. This phenomenon can be demonstrated by wetting the end of a thermometer. As the liquid evaporates, the temperature will drop.

The temperature drop through the carburetor is about 40 deg., but varies with different arrangements. This causes the moisture particles to be condensed out of the charge, and under favorable conditions these particles will cling to parts of the carburetor. The most comon ice accumulations are found around the throttle itself or butterfly valve. This is dangerous as it gradually closes off the passage, thereby reducing the power.

The second most common formation is found around the jet which sprays the gasoline into the air stream. This is dangerous as it increases the suction on the jet and makes the mixture very rich. This may continue until the engine will cease to operate. The ice thus formed is particularly dangerous as it decreases the available carburetor heat in two ways, first by reducing the power and second by enriching the mixture.



A typical engine installation in a lightplane showing the position of the carburetor directly below the engine with the air intake in front.

Effect of Weather Conditions

It is possible, to a great extent, to predict icing conditions although these predictions are not infallible. Carburetor ice may be expected in temperatures of less than 50 deg. where the dew point is less than 5 deg. below the prevailing temperature. To what extent the available carburetor heat will prevent the formation of ice is largely a matter of experiment, and varies greatly with the equipment and weather conditions. During actual precipitation the amount of carburetor required is somewhat greater. It is assumed that most of the light plane operation is done during fairly clear weather and that very little flying through overcast conditions is necessary or permissible.

The Cure

One positive method of ice elimination is suggested here which is required in airline operation where the carburetor heat available is sufficient to cause a 40 deg. temperature rise in the intake air. This makes use of Ethyl Alcohol or Anilol injected into the carburetor air intake. The installation consists of a supply tank of about 1 gal. capacity mounted inside the ship at some point where it can be filled conveniently and sufficiently high above

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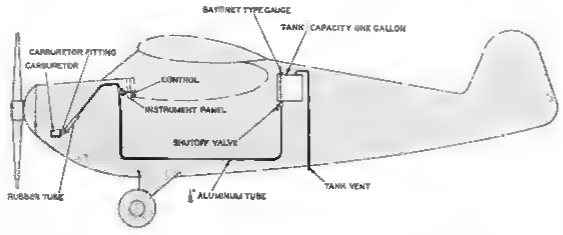
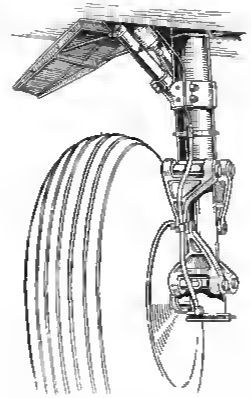
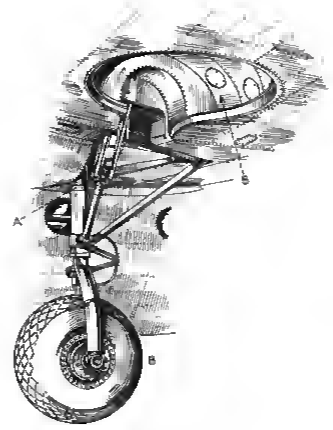


Diagram of the installation of a tank for Ethyl Alcohol or Anilol for injection into carburetor, preventing ice.

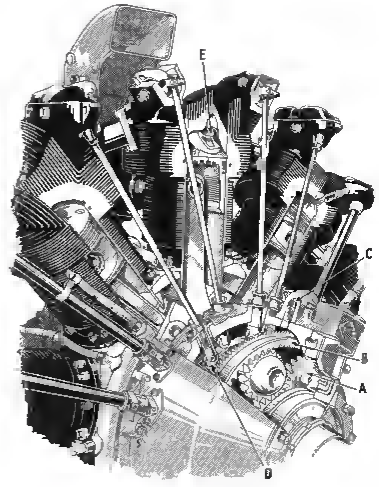
AVIATION SKETCH BOOK OF DESIGN DETAIL



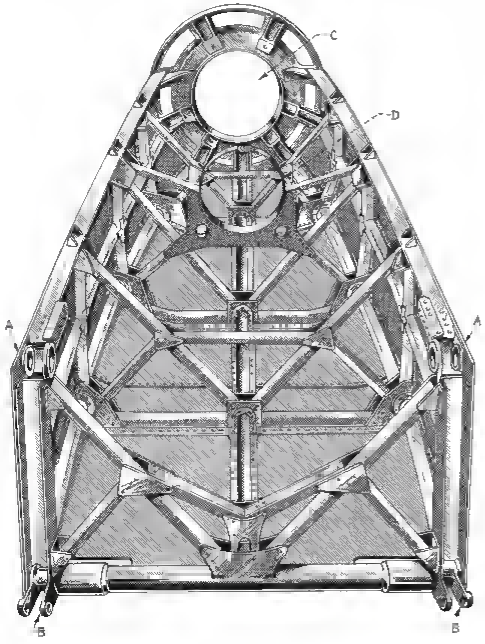
Shown above is the landing gear of the Douglas DC-4. With a ship of this size torque scissors are needed on the front and rear of the main landing gear strut to take the torque loads. The retracting strut is at the upper left, folding the wheel in towards the center of the ship.



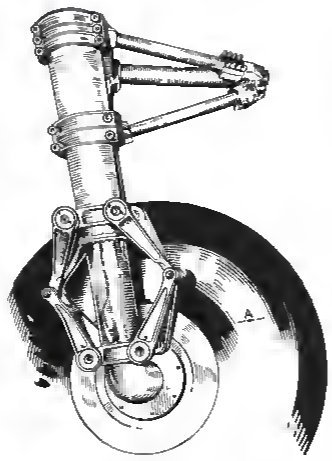
The Outward retracting landing gear of the Douglas DC-5. The brace hinged at "A", when pulled in towards the center of the ship pulls the wheel from "B" (below) up into the wing well at "B".



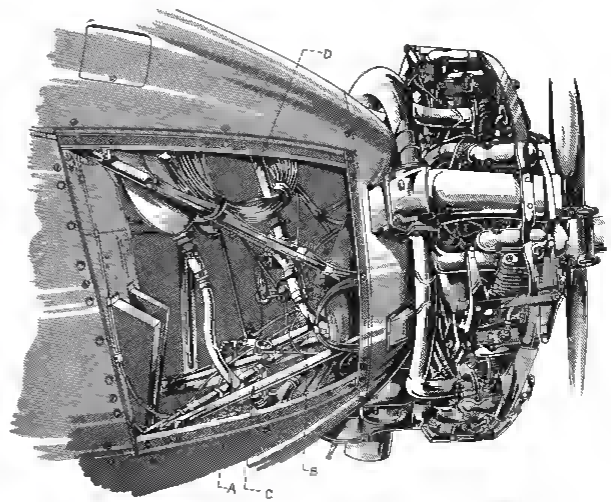
Cutaway drawing of the reduction gears of a Wright G-100 series engine is shown above. The planetary gears are shown at "A", revolving inside the annular ring "B". "C" is an auxiliary gear furnishing power for the pump located just forward of it. The cam follower for the exhaust valve pushrod is at "D". This is on the forward cam, with the similar arrangement for the intake valve located just to the rear. "E" is a sodium filled exhaust valve.



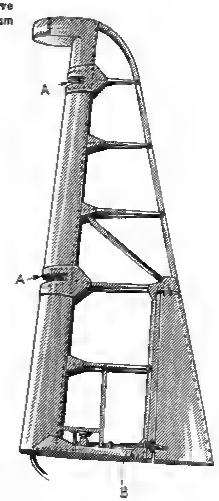
One of the features of the Dornier Muster Do 26 seaplane is the hydraulically operated engine nacelle for raising and lowering the position of the propeller (below). The rear section of the nacelle is hinged at "A" with the engine mounted in front of this section and the extension drive shaft to the propeller running through "D" to "C". During take-off members connected to "B", and hydraulically operated raise the nacelle, hence the propeller, for increased take-off performance. The engine is a Junkers "Jumo" 205.



The landing gear of the Douglas B-19 super-bomber. To indicate the size, the point "A" is the height of an average man. Notice the strut bracing at the top.



A Warner 165 horsepower engine installed in a Fairchild trainer M62B. "A" is the oil line running from the oil tank to the engine. "B" is the return oil line running up through "D" to the top of the tank. "C" is the lower section of the engine mount.



The elevator section of the Vought-Sikorsky V-143 has a box-type front spar with channel type ribs. It is both dynamically and aerodynamically balanced. Self-lubricated, sealed ball bearings are used in the hinges "A". Control for the adjustable trailing edge trim tab is at "B".

Stainless Steel Fabrication

By Frank M. Smith

General Manager, Stout Skycraft Corporation

WITH stainless steel entering more and more into use in the building of aircraft today, methods of fabricating and working it are becoming of great interest

A check of the research laboratories of the various steel companies, and of many prominent industrial concerns working on stainless steel reveals, however, a scarcity of data regarding the fabricating of high tensile austenitic stainless in rolled and formed shapes

It has been found that methods of rolling and forming familiar to the majority of manufacturers handling stainless steel in the tensiles utilized in the automotive and structural trades have had to be radically altered with the use of material having a tensile over 185,000 lb p s i Attempts to force the material harden it to the danger point, resulting in failure through cracking or buckling especially in the thinner gages

Figure 1 illustrates an improper design for a rib or longeron section where forming to a radius is necessary A flat top and square corners on the compressed section of the member will assure its failure, while a properly designed section, as shown in Fig 2, will allow for accurate and satisfactory forming

For forming light angles to a curve, the most satisfactory results can be obtained by crimping as illustrated in Fig 3, as the variance in hardness and tendency to spring back make draw bending or wiping too inaccurate without constant alteration of the jigs, dies or forms

The use of spot welding instead of riveting necessitates much more initial and accurate jigging as proper spot welds are dependent on faying surfaces both for strength of weld and smoothness of contour Fig 4 shows a spot welded structure fabricated on a proper jig, while Fig 5 shows the result of spot welding over an inaccurate jig

In order to eliminate unsightly conditions caused by spot welding thin skin to heavier gage structure, the skin should not only be tightly drawn over the structure, but spotting should be done by the divisional method. That is, the first spots ought to be located at extremes and center of the surface to be welded and subsequent spots at the centers of the unwelded sections progressively throughout. (Fig 4)

To eliminate the annoying and disturbing noises occasioned by the so-called "tin-panning" of flat surfaces in the structure, corrugating of such surfaces should be resorted to wherever possible Fig 6 illustrates a spar web with the usual Wagner truss which is especially critical to "tin-panning" in the many bays between verticals, while Fig 7 shows a beam section with corrugated web where "tin-panning" or noisy buckling is entirely eliminated Both of these samples have been stressed beyond the elastic limit diagonally

Fig 1 Improper design for rib or longeron section where forming to a radius is necessary. (Bottom section)

Fig. 2. A properly designed rib or longeron section. (Top section)

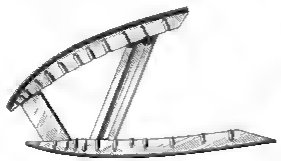


Fig 3. Crimping obtains the most satisfactory results for forming light angles to a curve

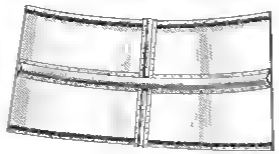


Fig. 4. A spot welded structure fabricated on a proper jig.

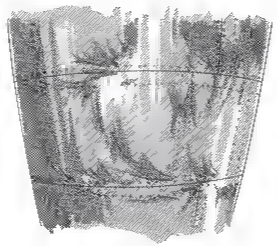


Fig. 5. Result of spot welding over an inaccurate jig.

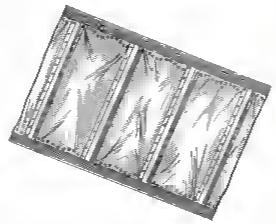


Fig. 6. A spar web with the usual Wagner truss which is especially critical to "tin panning" in the bays between verticles.

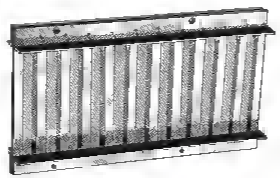
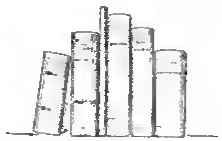


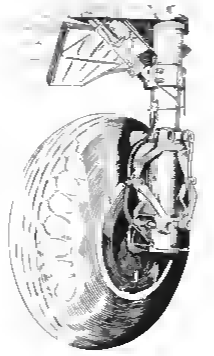
Fig. 7. Beam section with corrugated web where "tin-panning" or noisy buckling is eliminated.



IT ISN'T IN THE BOOK

SHOCK ABSORBING SYSTEMS

Part II of an article dealing with the problems of shock absorber systems of large military and commercial planes



DC-4 Main landing gear Strut in fully extended position

By Walter A. Semion *Hughes Aircraft Company*

PART I of this article, printed in the December, 1940 issue of AVIATION (p 80), presented a general description of landing gear structures and shock absorbers, the shock absorbing qualities of a tire, the functioning of pneudraulic struts, and strut action in landing and in taxiing

In the following section of the article solutions are offered to the problems presented in the previous material, and, with reference to the DC 4, the theoretical derivation of the main landing gear efficiency is given followed by a numerical example

Dynamic Testing

The primary purpose of the present day drop testing is to determine the shock absorbing qualities of the entire shock absorbing unit or its constituent parts, i e, pneudraulic strut and tire separately or in combination, rather than to determine the strength of the undercarriage subjected to a severe impact load However, at times it is necessary to run a series of special proof tests in order to verify the assumptions of the original design.

The Bureau of Air Commerce requirements for free

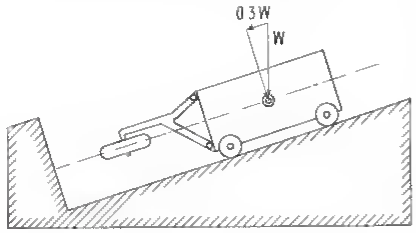


Fig 5 Scheme of DC-4 drop test rig up allowing for wing lift.

height in drop testing take into consideration the airplane landing speed as well as its vertical speed. The maximum vertical velocity of descent has been set by the Bureau at 700 feet per minute. The maximum free height of drop would thus be approximately 26 inches

The vertical speed and the amount of energy to be absorbed usually determine the drop test requirements however the airplane attitude on landing also has to be considered The weight of the airplane, the vertical sinking speed and the mass travel after contact determine the amount of input energy In actual landing the wing lift force tends to minimize the impact loads. At the instant of the tire contact with the ground the lift force is equal to the airplane weight, from that moment on the rate of decrease of the lift force will depend upon the airplane attitude On airplanes equipped with conventional gear the rate of change in three point landing tends to be greater than on aircraft equipped with tricycle type landing gears This is explained by the fact that on tricycle type aircraft the absolute angle of attack is always smaller, and consequently its rate of change will be less In an aerodynamic study of the action of the airplane in the landing run, it was found that the average value of the wing lift on the DC-4 was equal to 0.7g This value would be different for different airplanes since it depends on the landing angle, the angle of incidence of the airfoil the change of angle of attack during the landing run, and the landing speed (see Fig. 5) For the DC-4 then the total energy input was less by 0.7W times the maximum mass travel

The height of free drop for a given vertical velocity v will be

$$H = \frac{v^2}{2g} \qquad (2)$$

Equation (2) will thus become

$$E = W(H + t + s_c) \qquad (3)$$

Due to the weight of the lower part of the undercarriage W_L and the weight of the upper mass W_U the correction

[illegible] the total input energy

$$E = W[H + t + s_c(1 - \frac{W_L}{W_U + W_L})] \qquad (4)$$

where $W_L + W_U = W$

In Fig 2 the mass velocity ordinate at each instant will be $v = C_v - \frac{ds}{dt}$

and mass acceleration ordinate will be

$$g = C_a \frac{dv}{dt} = C_a \frac{d^2s}{dt^2}$$

where C_v and C_a are velocity and acceleration constants for a given space-time recording accelerometer

Referring to Fig. 3, the energy absorbed by the main gear is represented by the area under the curve OJDE Energy dissipated is included within the area OJDKL

Energy absorbed by the shock absorbing strut is represented by the area OFGBC Energy dissipated is the area OFGBHI

The Main Landing Gear Efficiency (η_l) will thus become

$$\eta_l = \frac{\text{Energy dissipated}}{(\text{Maximum Dynamic Load}) \times (\text{Maximum Mass Travel})} \times 100$$

or $\eta_l = \frac{\text{Area OJDKL}}{\text{Area OADE}} \times 100$

or $\eta_l = \frac{\text{Average Load Factor}}{\text{Maximum Load Factor}} \times 100$

In the first efficiency equation the maximum dynamic load will be

L = W (Maximum Load Factor)

The shock absorber strut efficiency (η_s) will be

$$\eta_s = \frac{\text{Energy Dissipated}}{(\text{Max Dynamic Load}) \times (\text{Max Strut Stroke})} \times 100$$

or $\eta_s = \frac{\text{Average Load Factor}}{\text{Maximum Load Factor}} \times 100$

or $\eta_s = \frac{\text{Area OFGBHI}}{\text{Area OABC}} \times 100$

The merit factor η_M of a strut takes into account the test weight W, height of free drop, strut stroke and the maximum load developed on a drop

$$\eta_M = \left(\frac{W}{L}\right)^1 \times \frac{H^1}{s_c} \times \frac{H^1}{H} \times 10^6$$

Where: L = maximum dynamic load developed
H^1 = height of given drop
H = height of required maximum drop
s_c = maximum strut stroke

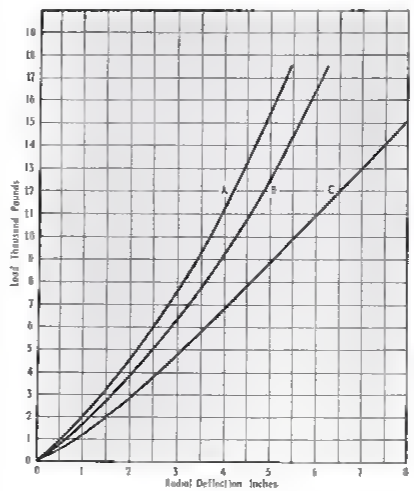


Fig. 1. Comparative load deflection curves for high and low pressure tires

A Tire—streamline—16 ply—size 45 in
O. dia. 43.30 in. sect width 14.42 in.
Rated max. static load 9,200 lb
Infl. pres. at max strut load 40 lb
Max. avail. radial deflect. 7.60 in
Approx. collaps. load 31,300 lb
Max energy absorbing capacity 9 080 ft.-lb

B Tire—streamline—8 ply—size 45 in
O. dia. 43.80 sect. width 14.40
Rated max. strut load 9,100 lb.
Infl. pressure at static load 42 lb p.s.i.
Max available radial deflect 7.75 in
Approx. collapsing load 25,800 lb
Max energy absorb. capacity 6,630 ft lb

C. Tire—low pressure 6 ply
O. dia 42.40 in sect width 14.60 in.
Rated max static load 7 000 lb
Infl. pres. at max strut load 20 p.s.i
Max available radial deflect 10.5 in
Approx. collapsing load 20 850 lb
Max. energy absorb capacity 9 430 ft.-lb

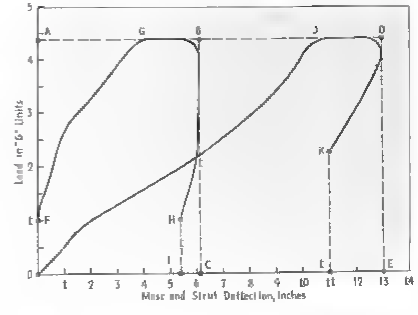


Fig 3 Pneudraulic strut and main landing gear efficiency diagrams.

Numerical Example

An airplane weighing 16,000 lb is to be tested to a maximum free drop of 26 inches The tires are size 45" 8 ply streamline capable of absorbing 4600 ft lb of energy each at a radial deflection of 6.5 inches The strut has a working stroke of 9 inches What should be the maximum efficiency of the strut so that the load factor does not exceed 5g?

The total input energy on 26-inch drop

$$E = \frac{16000}{2}(26 + 6.5 + 9) = 332000 \text{ in lb}$$

Energy absorbed by the tire from Fig. 1

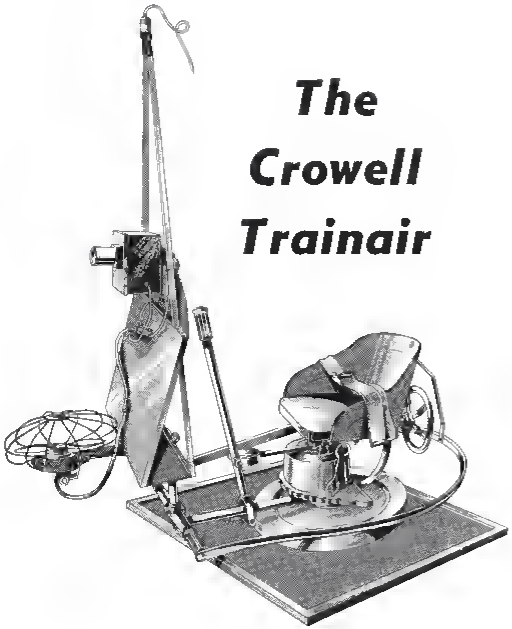
$E_t = 4600 \times 12 = 55200$ in lb

Energy absorbed by the pneudraulic strut

$E_s = 332000 - 55200 = 276800$ in lb

$$\eta_s = \frac{276800}{8000 \times 9} \times 100 = 77\%$$

The Crowell Trainair



A new on-the-ground training machine has been developed for teaching beginning students how to coordinate flight controls

A NEW device called the Crowell Trainair has just been put on the market for the purpose of familiarizing primary flight students with the handling of airplane controls. With the success of the Link Trainer firmly established for teaching instrument flight instruction, the possibilities of an on-the-ground trainer for beginning students is well worth considering.

The new trainer has been designed by John E. Crowell, a pilot of twenty years' experience. He has flown all sorts of airplanes under all sorts of conditions. He has built airplanes, barnstormed in Jennies, done aerobatics for years, and has taught scores of students—including two Chinese cooks—to fly. The trainer which is now on the market is the result of several years of intensive work. Each part was engineered to perform so that the over-all effect to the student is that of piloting an airplane in flight.

"We don't expect to teach students to fly in the trainer," said Mr. Crowell. "Obviously you can't learn to fly on the ground. The purpose of the trainer is to teach students to coordinate the movements of their hands and feet with the attitude they want in the airplane. If a student has 2 hr. or more of instruction on the trainer before he goes into the air he can do what his instructor tells him to do without conscious thought. If the instructor says, 'Get your nose up' the student's reaction is prompt. When the student is told to do a climbing left turn, he knows how to tie in the movement of the stick and rudder. Students who have put in time in our trainer before beginning actual flight instruction feel at home in an airplane. They sit relaxed, grasp the stick lightly, and are able to absorb instruction rapidly."

Details of the Crowell Trainair are seen in the accompanying photographs. The machine is extremely sensitive. It is balanced so delicately that moving the stick forward, or back, whether or not the propeller is in operation, lowers or lifts the nose. Likewise, movement of the stick from side to side changes the horizontal axis. However, as in an airplane, when the stick is moved from side to side in conjunction with the rudder bar, the action is more rapid. Movement of the stick affects the balance of the weight beneath the pilot's seat.

The motor at the front of the trainer drives a 12-in. wooden propeller. This is by no means a toy, as it produces a real thrust. When the trainer is simulating straight flight, the propeller turns in a horizontal plane. When the left end of the rudder bar is pushed for a left turn, the propeller plane is tilted to the left, and the pull of the propeller moves the nose to the left. In right turns the propeller is tilted to the right and draws the nose in that direction.

Students are taught to maneuver the airplane and make precise turns by aiming a tiny spotlight at a wood panel, on which is painted a series of flight paths. Beginning students have trouble in keeping the spotlight on the board. After several lessons they are able to aim it where they intend to.

The first lesson is in keeping the spot on the board. The next is in moving the spot from side to side on the horizontal line by use of the rudder bar, keeping the stick in a neutral position. Then the student learns to move the spot up and down the vertical line by using the stick, at the same time keeping the rudder bar level. Following this, he learns to coordinate the hand and foot controls by tracing the elliptical paths. The test of the machine is that an experienced pilot can immediately put the spotlight exactly where he wants it.

There are several auxiliary instruction aids in the trainer. The first is the use of safety belts. While the machine

(*Turn to page 122*)

John E. Crowell demonstrating his training machine to a group of students at the Academy of Aeronautics. The flight pattern board is at rear left.

Snogo clearing field at Des Moines Airport. No banks building up here

It's not healthy to land a plane in a snowdrift. Here is one good method in keeping them clean.

Winter Always Comes

By H. A. Scribner *The Klauer Co.*

It was an amazing thing to me that on inquiry, none of the major airlines could give figures or data as to the time lost by grounding due to snow.

Airport men cannot be expected to know all about snow removal, but snow removal has been a study, and I mean a study, for years by highway departments all over the country.

Many types of plows are in service and with few exceptions every type of plow is suited to some particular type of snow condition. The design of plows didn't "just grow" like Topsy either but resulted from careful studies by engineers on the movement of blades of different contours at different speed through snows of different character.

Experimentation by the airports has perhaps moved in novel directions which is to be expected, but it is strange that this experimentation appears to have been dominated by the cost cutting motive rather than by a wish to do the best possible job, and it is strange that an industry that spends millions on its equipment, and in which safety is of paramount interest, should be so motivated.

There is only one absolutely safe landing area for a ship, and that is a clean runway.

Four primary methods have been so far adopted or developed for making runways usable in snowy conditions. We won't say "clear" because some of them don't clear. These may be classified as (1) Air blowing; (2) Rolling; (3) Plowing by Push Plow, (4) Plowing with a Rotary or "Blower Plow," as our friends the Canadians, call them.

The air blowing method consists of using an airplane engine and propellor on some sort of vehicle for literally blasting the snow away by air force. Only under certain snow conditions has it ever been, or can it be, successful. That method can be forgotten at once.

Next comes rolling. This method due to its false claim of economy, has taken the attention of many airport operators. Let's run through the requirements. Beyond all question, the equipment has the desirable feature of being cheap. It consists of rollers made generally from corrugated iron pipe, ballasted either by bags or by other methods. These rollers generally are arranged in a triangular formation and dragged across the runway to compact the snow. When conditions are ideal it does a good job and leaves a runway firm enough for ships to land on safely. But conditions are seldom ideal. In the first place the snow is *still there*, ready to cause trouble under subsequent conditions. The method will not handle dry powdery snow, and it must be harrowed to thaw it sufficiently for compaction or a natural thaw from the heat of the earth must be waited for. If a sleety icy condition prevails, harrowing or dragging must again be resorted to, or compaction is impossible.

When occasional thaws or spring thaws occur, the snow close to the ground melts first and it is possible for a surface crust to remain over pot holes, with no support below whatever. On some airports, snow compaction has been 15 in. or more. Such a hole would provide quite a drop for a landing ship, and could result in "prop" or engine damage or more. When thaws occur, additional time and expense must be invested in again harrowing the field and perhaps rerolling.

Some claims are made for the visability of the runway when rolling, as the imprint of the roller leaves a shiny surface when viewed from the side toward the sun, and a dark surface when away from it. For visability there is no substitute, however, for a runway that has had the snow cleared completely from it.

Many fields are using plowing. Some are doing the job with straight blades, either of the road maintainer type, or of the type that fits on the front of a truck or tractor. Others are using the V-type, generally designed for primary highway clearance.

These machines will remove the snow down to the surface of the runway and do a good job. They have, however, several outstanding faults from the standpoint of airport clearance. A highway is relatively narrow, as compared with a runway. In handling snow of any depth over the wide area of 100 ft. or more the push plow must spend hours in *rehandling* snow. The average width of a blade is 8 to 9 ft. That means 11 passes to every 100 ft. With a hypothetical problem, let's just see how much snow is in 1,000 ft. of runway. To make it simple, we'll take an inch of snow, though, of course, nobody would even bother to plow so little. Assume that the natural action of the plow did not throw it aside, but kept it in the front of the plow. At the end of 1 000 ft., using a 9 ft. blade, you would have 750 cu ft. of snow equal to a rectangle $10 \times 10 \times 7\frac{1}{2}$ ft.—enough to bury the plow. Compaction naturally takes place and actually the cubic contents of your load, depending on the density of the snow, would only be perhaps 300 to 350 cu ft. On that basis with 1 ft. of snow, you would have 2,200 to 4 500 cu ft. at the end of your plow's run, depending again on the compaction.

The action of a plow naturally is such that the material is skidded or thrown to the side. This results in a continuous piling up of snow for the tractor or truck to rehandle, and the steady com-

paction makes the load continuously heavier Thus, in snow of any quantity, the final result is that the tractor must perform a series of hunching operations at right angles, and shove the snow directly to the sides of the runway Just visionalize how much backing and filling this means in 1 000 ft of runway with a 9 ft. blade It figures out about 112 times Suppose, too, this has to be done over 50 ft or ½ of a runway 150 ft. wide The tractor would cover over two miles of distance as it must both go in and out over the 50 ft Total this up on the full length of your runway A medium tractor with an ordinary blade will open somewhere around two miles of road an hour in 6 to 8 in of snow From this you can arrive at costs and time required to clear your own fields under your own snow conditions

The V-type plow, of course, generates a throwing action and will toss the snow fairly well back, but not enough to avoid rehandling

It also has another disadvantage from the standpoint of airport clearance, and that lies in the fact that only one half the plow is usable after the initial cut

As compaction builds up, there is a tendency, too to force the plow out into the cleared area

Finally, when your runway is cleared regardless of the type of plow, you find yourself with banks varying in height depending on the original depth of the snow and its density and with each succeeding snow the runways become narrower and narrower

Banks are often so high as to seriously endanger wing tips They act, too, as traps for blown snow and are themselves blown down to drifts which again call for expensive rehandling and unfortunately they are very likely to weather the short thaws and remain all winter as a continuous source of trouble and danger through the entire season

Finally we come to the rotary or auger type of plow This machine picks up the snow and throws it to distances of 150 to 200 ft, depending on the wind, and scatters it over the unused areas of the field These machines have for years been serving the highway department of the country, but due to their cost which, until recently, was high, the airports have not taken kindly to them in spite of the fact that their adaptability to airport problems was far beyond that of any other type of machine Even this is strange—that on the one hand manufacturers are willing to go to tremendous expense to develop machinery for safety and better flying, and on the other hand these same manufacturers hesitate at a few thousand dollars to assure safety

Working at night Note the sharp edge of the snow wall

for expensive equipment during snowy conditions when one washout would pay for a good rotary

Rotary plows today are priced to be in reach of every airport Their advantages are many For those not familiar with rotary or blower type plows, we'll picture one

The business end consists of a row of three augers that carry the snow to a central opening in the plow itself Here it is picked up by a high-powered fan and discharged at a high speed through a discharge spout. The plow is driven by its own engine through a transmission of many speeds All controls are in the cab and the discharge can be raised or lowered or moved to throw to either side at will. Two way radio is easily installed and many of the plows in the west are so equipped The units are heated equipped with light and carry enough fuel for 24 hours' operation

The beauty of the rotary plow lies in the fact that it does the job *once and for all* No snow worth mentioning is left on the runway to thaw and freeze into dangerous ruts or pot holes Edges are sharp and clean cut, free from banks that continually grow higher with each succeeding snowfall and often remain until spring, regardless of other thaws There is no tendency for the runway to narrow down with each new snowfall accumulation as with push plows, which, unable to get the snow beyond the frozen edges, must pile it ever higher and higher to the danger of all concerned.

The rotary plow moves back and forth the length of each runway, throwing the snow into the unused areas of the field without any of the delays or waste of fuel that comes with rehandling

The quality or character of the snow does not affect operation Wet, or ice-laden snow, is handled with the same ease as dry

Where desired, a loading device is provided and on some airports the practice has been to windrow the snow and then load it into trucks and get it out of the way completely

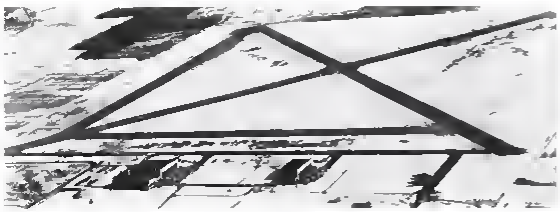
Loading mechanism can be removed from the machine However the mechanism is so flexible that snow can be thrown to either side without its removal

Rotary snow plows come in a range of sizes from the 1½ ton Marmon-Herrington four-wheel drive Ford conversion job to the largest four wheel drive type of truck

After the snow season the snow collector and power unit can be removed and the truck is available for other purposes

Rentschler Field, at East Hartford Conn., is among the oldest users of the rotary plow for airport service Mr. Whelan has had much experience in airport operation, and points out that they have tried many methods for handling snow, including rolling He says however, that the rotary plow is the first method that has done a really satisfactory job

Winter always comes, and if we are to have all-year flying we must have winter flying, and to make winter flying safe too good a job can't be done. Proper snow clearance can be turned to an advertising asset that commercial transport companies could also take advantage of While the fear of winter flying has been fast decreasing, there are beyond any doubt, people that will not fly in the winter months To show these people that the modern airport is *really* cleared by modern equipment will go a long way toward improving the winter state of mind and the state of mind on flying in general



Runways at Rentschler Field, East Hartford Conn., are clean and sharp in all weather

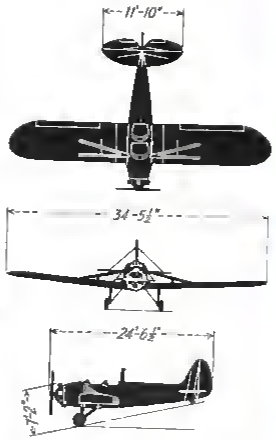
Wally Timm Aero-Craft

A new trainer designed for secondary training

Flying EQUIPMENT

APPROVED by the CAA for secondary CPTP instruction work, the new Wally Timm Aero Craft advanced trainer is now in production. Designed to meet the needs of civilian flying schools, the Aero-Craft is particularly suitable for cross-country flight instruction and for aerobatics. Construction is of conventional mixed type, with steel tube fuselage and wood wing structure, fabric covered throughout, providing for minimum maintenance costs. Powered with a Kinner R-5 engine of 160 hp, the plane has a cruising range of 3.5 hr., a service ceiling of 17,950 ft., take-off time at sea level, fully loaded, of only seven seconds, and initial climb of 1,100 ft. per minute. Cruising speed is 115 m.p.h. and top speed 125 m.p.h. It is the quick take-off, high rate of climb, high service ceiling, and relatively long cruising range which adapt this plane so well to all types of cross-country flight instruction. The ability of the plane to right itself automatically from any position is also a factor in aerobatic instruction. The plane will also be available shortly with a Kinner 175-hp. engine for advanced flight instruction, or for sportsman pilot purchasers, and can be obtained with side-by-side seating instead of the standard tandem arrangement. Fuselage, wing stubs, and tail group of the Aero Craft are of steel tube construction, fabric covered. The wings employ solid spruce spars and truss type spruce ribs, fabric covered. Outer wing panels attach to the stub wings by simple pin fittings and are braced to the fuselage top longeron by means of compression struts. Landing gear is fixed, of tripod braced construction, with compression strut from the main attachment point on the front spar of the wing stub, to the fuselage upper longeron.

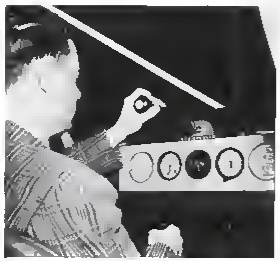
Span of the Aero Craft is 34 ft. 5.5 in., length 24 ft. 6.5 in., and height 7 ft. 2.5 in. Wing area is 175 sq. ft. and gross weight 1,916 lb. The plane is manufactured in Glendale, Calif., by Wally Timm, Inc., a project of one of the two Timm brothers, Wally and Otto, pioneer flight instructors, plane designers and manufacturers.



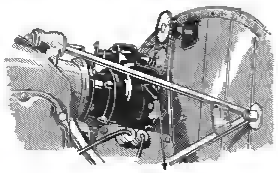
The new 1941 Piper coupe.

NEWLY DESIGNED PIPER COUPE

WHILE the external design of the Piper Coupe remains much the same as last year, many improvements in design detail and equipment have been included in the 1941 version. Most significant announcement is the fact that the Coupe (as well as the Cruiser) has been equipped with an engine starter as a standard item



How to work the starter. Twenty to thirty easy turns does the trick then push in.



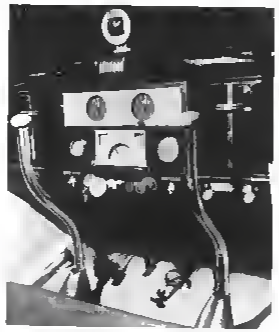
An under-the-hood view of the starter mechanism. The shock cord at the bottom (see arrow) goes to the tail post and is wound up by the gear and chain.

The starter is practical in operation and does not use electricity. Its power is derived from a shock cord extending through the fuselage to the tail post. To start the engine the pilot winds a removable crank in the instrument panel, twenty to thirty turns, then by pushing the starter forward (see photograph and drawing) it is engaged with the engine, giving it two complete revolutions. Incidentally the whole starter mechanism weighs only ten pounds

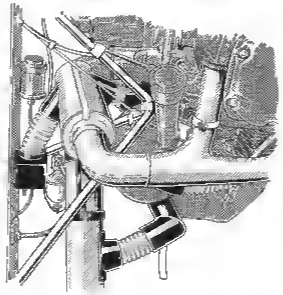
The interior of the ship has been completely re-styled. As standard equipment a custom built radio by RCA is mounted on the right side of the instrument panel with the only parts visible being the dial band and the two turning knobs. A custom built transmitter is available for installing in one of the two glove compartments on either side of the instrument panel. The tachometer, oil and temperature gages are one integral instrument while the compass by Carwil, is mounted above the panel. Altimeter and air speed complete the group of standard instruments

For additional electrical current a wind driven generator is included and installed between the landing gear. This apparatus was custom built for the coupe, with a charge indicator on the instrument panel as well as a rheostat to control the rate of charge. Navigation lights and battery are also included as standard equipment

Performance has been increased with the installation of the Continental 75 hp motor. It cruises near 100 mph. and lands less than 40 mph. Cruising range is 500 miles with a gas tank of 25 gallons



The new instrument panel showing the radio at the lower right, instrument cluster, and starter and compass at the top



Drawing shows exhaust system installation in the new Piper.

Flying EQUIPMENT

三菱MC20型旅客機

THE MITSUBISHI MC-20 JAPANESE TRANSPORT

With the current interest in commercial versus military priority in aircraft it is interesting to note what developments in design are taking place in Japan

By Paul H. Wilkinson, *Consultant Diesel Aviation*

ALTHOUGH most of the passenger carrying airplanes used by Japan Airways and its associated companies in the Orient are of American origin, recently there has been a concerted effort on the part of some of the leading Japanese manufacturers to design and build their own equipment. One of the most interesting airliners which has been produced to Japanese designs is the Mitsubishi MC-20. Details of this new twin-engined plane which have just been received disclose that its engines also are of Japanese design and manufacture. Furthermore it is understood that the MC-20 is to be manufactured for export as well as for domestic use.

Primarily the Mitsubishi MC-20 has been designed for long-range transportation of passengers, mail and express. As its take-off requires a run of 545 yd. it can use fairly small airports. Its normal range of 1,240 miles and maximum range of 1,865 miles enable it to undertake flights of considerable length without landing. Its maximum speed of 266 m.p.h., its cruising speed of 193 m.p.h., its landing speed of 75 m.p.h. and its service ceiling of 23,000 ft. place it in the same category as contemporary American and European airplanes.

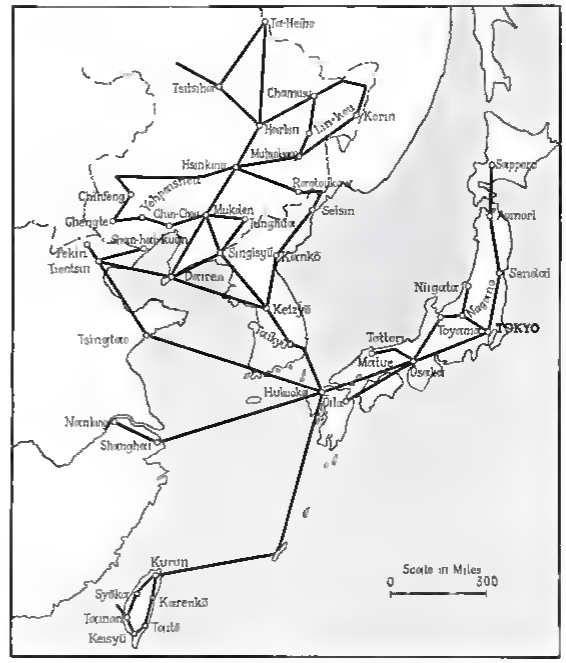
In construction the Mitsubishi MC-20 conforms with modern all metal airplane practice. The fuselage is 5 ft. 6 in. wide and accommodates 11 passengers in comfortable armchair seats. To the rear of the passengers' cabin is a lavatory and a baggage compartment. The pilots' compartment in the nose accommodates a crew of four comprising a pilot, a co-pilot, a radio operator and a navigator. Complete instruments are carried including an automatic pilot and a direction finder. Mail and express up to 660 lb. in weight are carried in compartments in the nose and behind the passengers' cabin.

The wings are of full cantilever construction and are built in three sections. The center section attached to the underneath side of the fuselage is relatively short and the two outer sections carry the two engine nacelles as on the well-known Junkers Ju 86 airplane. The tail surfaces are also of cantilever construction and the rudder and elevators are provided with trimming tabs. The landing gear is hydraulically operated and retracts forward up into the engine nacelles.

The wing span of the Mitsubishi MC-20 is 74 ft. 0 in. and its overall length is 52 ft. 9 in. Its height is 16 ft. 2 in. The total area of its wing surfaces including the underneath side of the fuselage is 755 sq. ft. The wing chord at the root is 15 ft. 1 in. and at the tip it is 4 ft. 9 in. The dihedral angle of the outer sections of the wings is 7 deg. and the sweep back is 10 deg. 43 min.

The power plants comprise two 14-cylinder Mitsubishi Kinsei air cooled ruhals which have a take-off rating of 1,040 hp. each and a normal rating of 850 hp. The engines are supercharged and give the airplane a good performance at a cruising altitude of 7,000 ft. NACA cowlings are used around the engines and the latter are equipped with electric starters. Three bladed propellers 10 ft. 6 in. in diameter are standard equipment.

Three-quarter front view of new Mitsubishi MC-20 11 passenger airliner



FOREIGN

Flying EQUIPMENT

The map at the left shows the extensive routes now being flown by Japan Airways, Manchoukuo Aviation Co. and the China Airways Co. All three lines are controlled by the Japanese Bureau of Civil Aviation. These commercial routes have been of inestimable military value to the Japanese in their war with China.

The weight empty of the Mitsubishi MC-20 is 11,900 lb. and its gross weight is 18,300 lb. Included in the useful weight of 6,400 lb. are 2,710 lb. of gasoline and 220 lb. of lubricating oil. The payload comprising 11 passengers and mail and express weighs 2,360 lb. This gives the airplane a wing loading of 24.2 lb. per sq. in. and a power loading of 8.8 lb. per hp. A maximum gross weight of 19,750 lb. is permissible which includes 4,080 lb. of gasoline and 310 lb. of lubricating oil. The range of the airplane is then increased to 1,865 miles.

Specifications

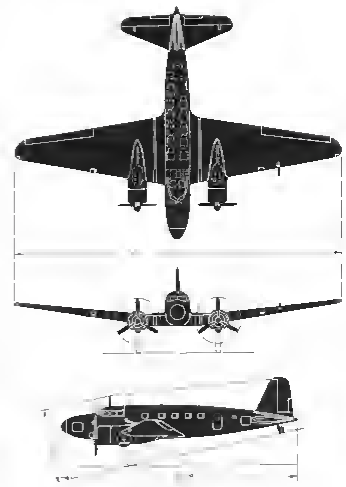
Wing span	74 ft. 0 in.
Overall length	52 ft. 9 in.
Height	16 ft. 2 in.
Wing area	755 sq. ft.
Weight empty	11,900 lb.
Useful load	6,400 lb.
Gross weight	18,300 lb.
Maximum speed	266 m.p.h.
Cruising speed	193 m.p.h.
Flight range	1,240 miles
Service ceiling	23,000 ft.
Total engine power	2,080 hp.
Wing loading	24.2 lb. sq. ft.
Power loading	8.8 lb. hp.

It is understood that arrangements have been made for the Mitsubishi MC-20 to be manufactured in considerable quantities for export as well as for domestic use.

Considerable progress has been made in civil aviation in Japan during the past two or three years. Part of this progress can be attributed to Japan's policy of keeping up with the times and developing civil aviation to the limit. Part of it is due to the hostilities in the Orient and the need for rapid transportation of supplies and mail.

Japan Airways, or Dai-Nippon Airways Company, operates in conjunction with the Manchoukuo Aviation Company and the China Airways Company an extensive network of airlines stretching over the Japanese Empire, Manchoukuo and North China. All three companies are under the control of the Japanese Bureau of Civil Aviation. Radiating from Tokyo their air routes reach as far north as Sapporo on the island of Hokkaido, west to Mukden, Peking and Shanghai, and south to the island of Taiwan (Formosa).

Most of the equipment used on the main air routes consists of Douglas DC-3 twin-engined airliners. Single-engine Beecheraft and other American and European airplanes are used on the local routes. As an example of the time saved by using air transportation, it takes 2 days by boat from Tokyo to Kiezyo (Seoul) in Tyosen (Korea) but only 5 hours by air. A letter sent by air mail from Tokyo to Osaka is flown over the 353 miles separating the two cities in less than 90 minutes. In time it is hoped to have an air route between Tokyo and Guam which will save considerable time between Japan and the United States.



Flying EQUIPMENT

The Stinson Voyager

A 90 Horsepower Three-Place Light Plane

The built-in wing slots on the Stinson Voyager are designed to make the plane spin proof and together with the wing flaps to reduce landing speed.

The windshield is re-designed for better visibility. The ignition switch has been relocated at the bottom center of the instrument panel and is easily reached from either pilot seat.

THE STINSON VOYAGER, a new 90-hp three-place airplane for the private owner has been announced by Stinson Aircraft, Division of Vultee Aircraft, Inc. The new plane, equipped with electric starter and generator, is an improved design of the famous Stinson 105, which has been lauded for its safety record during the last two years. Much of this is due to its built-in slots and flaps which have been retained in the new Voyager model for 1941.

The Voyager has a top speed of 115 miles an hour. It is a more powerful model than the 105 and standard equipment includes a 90 hp. Franklin engine, hydraulic brakes, parking brake, wheel pants, steerable tailwheel and bonding for radio. The engine develops its 90 hp. at 2500 r.p.m. and uses a larger diameter propeller. Take-off run with full load for the Voyager is reduced to 550 feet while the rate of climb has been increased 20 per cent up to 600 feet a minute. Service ceiling is 13,000 feet.

The new instrument panel has provision for radio installation while all control buttons and switches have been re-arranged for ease of operation. The interior of the ship is done with two-tone Laidlaw broadcloth. The cabin doors have been insulated for greater cabin quietness while the contour of the windshield has been changed to minimize deflection. The new master switch is of the heavy-duty knife type and has been relocated in the center.

EQUIPMENT

90 hp. "Franklin" Engine
Dual Magneto Ignition
Automatic Valve Lubrication
Hydraulic Valve Tappets
Carburetor Heater
Metal Tipped Propeller
Storage Battery, 6 volt
Springdraulic Shock Absorbers
Hydraulic Brakes
Parking Brake
Full Swivel Tail Wheel
Ball and Needle Bearing Controls
Flaps, N.A.C.A. Balanced Type
20-Gallon Fuel Tank
Dual Wheel Controls

Instruments: All indirectly lighted. Compass, airspeed indicator, altimeter, rev-counting tachometer, oil pressure and temperature gauges, electric fuel gauge.

WEIGHTS

Empty weight* (including above equipment)	948 lb
Useful Load	
3 persons	510 lb
20 gallons Gas, 1 gallon Oil	128 lb
Baggage and Extras	39 lb
Gross Weight	1625 lb

*Subject to plus or minus 2% variation.

PERFORMANCE*

Full Load

Maximum Speed at Sea Level	115 m.p.h.
Landing Roll	150 ft.
Rate of Climb	600 ft.p.m.
Service Ceiling	13000 ft.
Takeoff Run at Sea Level	550 ft.

*Subject to plus or minus 3% variation.

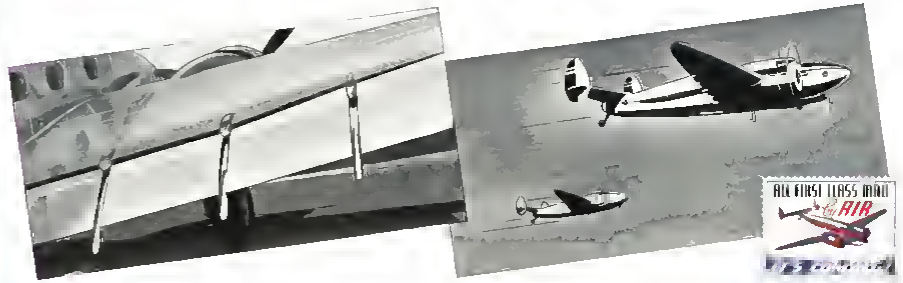
THE *Lockheed* LOG

LEADERSHIP *in Speed!*

SPEED--the very essence of the growth of air travel. Speed--often the vital difference between life and death in a fighter. Speed--that allows a peace time transport to be transformed into a famous bomber.

"Lockheed engineered" stands for that kind of speed. And it's good business when you realize that greater speed permits longer flights during daylight...cuts working time of flying personnel...allows more revenue miles per flying hour...and more miles between overhauls.

But just speed is not enough! It's speed with dependability...speed with all 'round performance...and speed with economy that has made Lockheed commercial transports, the nation's fastest, famous the world over. And now from that great reservoir of experience in "engineering for speed" has come the Lockheed P38, a fighter in that distinguished 400 mile per hour class...and a capable defender of democracy.



Speed with safety is a Lockheed creed! That's why the most effective, high-lift device known in modern aviation...the Fowler Flap, was adopted and developed, then installed on fast Lockheed transports and military airplanes. The above illustration shows one of the flaps in extended position for landing.

It still takes a Lockheed to beat a Lockheed! In 1938 a standard Lockheed 14 shattered all records for transport airplanes, by flying across the continent in 10 hours, 33 minutes and 59 seconds. On November 2, 1940 a newer Lockheed, the Lodestar, chipped 1 hour, 4 minutes and 20 seconds from this unchallenged record.

LOCKHEED AIRCRAFT CORPORATION · BURBANK CALIFORNIA, U.S.A.

LOOK TO *Lockheed* FOR LEADERSHIP

Printed in U.S.A.

Aviation's Battle of Production

By Selig Altschul

WHILE airplane production holds the spotlight in our rearmament effort, aircraft stocks continue to perform in desultory fashion.

Such market behavior merely reflects the many uncertainties facing the industry today. Judged by normal standards, the aircraft builders should have a highly encouraging outlook. A record year of production was completed during 1940, registering a gain of 180 per cent in dollar sales over 1939. The industry's backlog at the outset of 1941—estimated at about $3,500,000,000, compared with a total of $675,000,000 a year earlier, and $175,000,000 two years ago. Ordinarily such growth manifestations would find an instantaneous response on the part of the investing public.

However, these are no ordinary times. While fears of complete nationalization of the aircraft industry may have subsided somewhat, this bogey is not completely inanimate. Moreover, the fact remains that the government has the most important stake in the aircraft industry today. Financing new assembly plants and the application of a guaranteed bankable-contract to facilitate expansions of existing facilities have vested the federal authorities with new powers of control. More importantly, the prerogative to award contracts is in itself a potent force in the control of the aircraft industry.

The aircraft manufacturers now have virtually but one customer—the United States Government. No longer can foreign markets be sold on a profitable basis. As indicated in these columns a few months ago, the policy of greater aid to Britain has finally reached the stage where for all practical purposes England will no longer place the actual orders. The provisions of the "lease-lend" bill would translate into tangible action the previously announced administration intention to turn over to the "defenders of democracy" all implements of war.

Aircraft and other armament appropriations as contained in the "regular" budget as submitted to Congress for the next fiscal year no longer carry the same implications they once did. While a record total of $10,800,000,000 was itemized for national defense, only $460,000,000 was indicated for new Army plane orders—a decline from the previous year. Supplementary appropriations, however, appear in the offing. The War Department is reported as seeking an additional $2,000,000,000 with which to purchase about 15,000 planes. Even this additional program may fail to meet new demands. No indication is given as to the extent of planes to be "loaned" England.

It may be a safe assertion that the power to produce will be the only limit to defense spending for aircraft and other armaments.

On the assumption that private aircraft firms will continue to operate their plants either as owners, or, in the case of the new assembly plants, as agents of the government—and we are willing to make that assumption—*the key to satisfactory results will lie in the profit margins prevailing on the production volume to be manufactured during the coming period.*

While profits for the year 1940 attained record levels the gain in the balance remaining for stockholders was not so great as that in sales—largely because of increased taxes and the loss in efficiency due to plant expansions and other factors. The year 1940 probably represented the most opportune year for the industry to record substantial profit margins as deliveries were made in volume on profitable foreign contracts. While it is anticipated that sales on original foreign business will continue in volume during the present year, that type of backlog will be but a passing fancy to the discerning investor who sees the rapidly mounting U. S. government awards representing low profit-margin deliveries in the not-too-distant future.

It appears fairly conclusive that high profit margins are rapidly becoming a thing of the past wherever it may have existed in the aircraft industry. What then of the productive capacity of the aircraft builders? The industry was not and is not today, prepared to handle its bulging backlog of orders. An expansion program, unparalleled in American industrial enterprise, had to be undertaken. It was partly because of this expansion and the addition of large numbers of new and untrained workers, that manufacturing efficiency was impaired thus contributing to the curtailment of profits last year.

Expansion has not been confined to the aircraft builders. Extensive subcontracting has enlarged the productive capacity of the industry even further. The building of parts and sub-assemblies by the automobile and other industries is expected to play an important part in future aircraft production.

The widespread application of subcontracting in the aircraft industry has another interesting aspect. As the aircraft builders "farm out" segments of their ever-mounting awards, important dilutions are being made in their reported backlog of orders. In other words, for all practical purposes, stated backlogs of the primary aircraft builders no longer present a true picture of the business to be directly produced. Moreover, sub-contracting is believed to be an expensive operation resulting in reduced profit margins for the aircraft manufacturers.

The demand for expansion of productive facilities is so great, however, that insistence upon further sub-contracting will probably continue. Interestingly enough, many of the small factories now outside the pall of defense

(Turn to page 114)

TABLE I

Market Action of Aviation Securities
Dec. 31, 1939 to Dec. 31, 1940 and Dec. 31, 1940 to Feb. 7, 1941

	Dec. 31 1939	Dec. 31 1940	% Change	Feb. 7 1941	% Change
Air Transport					
American Airlines	46	59	+28	47	—20
Eastern Air Lines	31	36	+16	27	—25
Pan American Airways	16	15	—21	14	— 6
Penn-Central Airlines	12	14	+17	12	—14
Trans. & Western Air	12	17	+41	15	—12
United Air Lines	16	16		14	—13
Aircraft					
Boeing	22	18	—18	17	— 6
Consolidated	28	27	— 7	26	— 4
Curtiss-Wright	10	9	—10	9	
Douglas	82	77	— 6	68	—10
Lockheed	32	27	—16	24	—11
Martin	41	30	—27	28	— 4
North American	20	17	—15	16	— 7
Sperry	38	30	—21	33	—10
United Aircraft	47	42	—11	38	—10

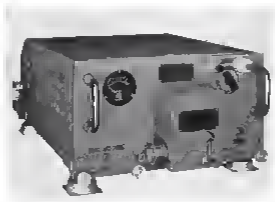
Aviation—RADIO

Dialing the Air Waves with Don Fink

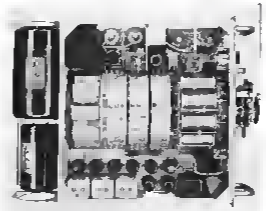
New U-H-F Airport Transmitters

Developed primarily for airport traffic control, but useful in a variety of u-h-f communications services are three new transmitters recently announced by the Radio Receptor Corp. of New York. Types 427 and 427A are 50-watt output units, covering the range from 128 to 132 and 140 to 144 Mc respectively, with frequency stability of plus or minus 0.01 per cent. These transmitters employ a 6F6 crystal oscillator, two 6N7's and an 832 as frequency multipliers, and an 829 as final r-f amplifier. A 6SC7 acts as input audio amplifier followed by 4 6L6 modulators. A 6H6 diode acts as a monitor tube. Input power from the power line is 500 watts at 60 cps, 110-120 volts. The audio frequency response is flat from 100 to 4000 cps, with 5 per cent distortion.

The power output of the type 428 is 125 watts, over the range 128 to 132 Mc., with the same frequency stability and audio specifications as the type 427. The power input is 1300 watts. The r-f tube line-up is the same as the type 427 except that a final r-f amplifier employing two 75T tubes follows the type 829 intermediate amplifier. The audio system employs the same audio input tube, but uses two type 811 modulators driven by four 6F6 pentodes. Voltage regulator tubes, type VR-150-30, are used in all three models to assist in maintaining frequency stability. Tuned circuits of the transmission-line type are used in the final amplifiers, and relays are employed to assist in starting the transmitter without injuring tubes due to inadequate filament heating time. The cabinets in which the transmitters are mounted are 37⅞ inches high, 18 inches deep, 25⅝ inches wide for model 427, 51½ inches wide for model 428.



Bendix RTA-1 transmitter-receiver



Top view of the RTA 1

Arince-Bendix Airline Transmitter-Receiver

The Bendix Radio Corp. of Baltimore has released details on the model RTA-1 airline transmitter and receiver designed cooperatively by airline engineers working through Aeronautical Radio, Inc. This equipment is of particular interest because, under the terms of the contract between Bendix and Arince, engineers of both organizations consulted cooperatively with airline engineers to produce the final design. The transmitter is a ten-channel 50-watt radio-telephone, covering the range from 2500 to 13,000 kc capable of full power output, 100 per cent modulated, over the entire frequency range. Motor driven selection of the various channels is ordinarily employed. 7 seconds or less being required to complete any channel shift (less than one second between immediately adjacent channels). The channels may also be shifted manually by a hand-crank in the event of a failure in the motor system. Frequency control, by quartz plates, is stable within 3 cps per million per degree centigrade. The power requirement at 100 per cent modulation is 462 watts, 12.5 volts at 37 amperes, or 25 volts at 18.5 amperes.

The audio frequency system covers the requirements of voice intelligibility, 500 to 3000 cps within plus or minus 3 db., distortion less than 10 per cent, 0.3 volts audio input across 100 ohms being sufficient to produce full modulation. The tube line-up consists entirely of beam-power tetrode amplifiers: a 6L6 crystal oscillator, two 807 r-f amplifiers, two 807 modulators, and a 6V6 speech amplifier. The 6L6 oscillator also serves as a heterodyne oscillator for the associated receiver. The transmitter operation is indicated by a meter on the panel, which is connected by a rotary switch to indicate six different voltages and currents: oscillator plate current, p.a. grid current, p.a. plate current, modulator plate current, filament voltage and receiver high voltage.

The associated receiver, mounted in the same housing with the transmitter, offers ten channels tuned simultaneously, by the motor drive, with the transmitter channel selector. The tuned circuits are mounted on an easily-removable rotating turret. The sensitivity is two microvolts at 4-to-1 signal-to-noise ratio over the frequency range from 2500 to 13,000 kc. Selectivity is 5 db down at 4½ kc., 60 db down at 18 kc. I-f and image rejections are all better than 60 db. The audio characteristics are approximately the same as those of the transmitter, plus or minus 3 db from 350 to 2500 cps. Power output of 300 milliwatts is available from the 500-ohm output.

An over-voltage limiting device placed in the initial r-f stage permits reception with high inputs.

RCA Announces Rotatable Loop

A rotatable loop antenna, for use with any conventional aircraft receiver, has been announced by the RCA Manufacturing Company under the type numbers AVA-56 and AVA-56A. The loop is a standard balanced-winding shielded assembly weighing slightly under 5 lb., 12 inches in diameter, and fitted with any of three types of remote rotating controls. The model AVA-56 is supplied with a locally-controlled fixed extension shaft, either 10 or 30 inches long, whereas AVA-56A is controlled by a flexible shaft with hand crank and azimuth indicator. The inductance of the loop is 40 microhenries, its capacitance 20 micromicrofarads. Auxiliary kits consisting of antenna coil, loop compensating coil, loop relay and loop capacitor are available to permit its use on the long wave band, or on the broadcast band. The loops are specifically designed for the AVR-7 series receivers, but are readily adaptable to other receivers of similar sensitivity.

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

What goes on in your stockroom? Stackbin Corp., Providence, R. I., offer to strengthen the "weak spots" in stockroom storage and handling with their Stackbins-in-Stackracks. Jig, fixture and die parts may be kept handy in individual hopper-fronted bins which slide like drawers into individual racks. Stackracks, built of channel and formed steel in sizes to take boxes, automatically lock together to form a strong, rigid structure of any size and shape. Stackbins not only take less space and bring parts nearer the workman's hands, but replace open pans in assembly work and are ideal for laying out work in toolmaking. Standard sizes of the bins range from 3¼x6x3½ in. to 15x24x11 in., any other size can be furnished in 14 to 20 gauge as desired—AVIATION, *March, 1941*

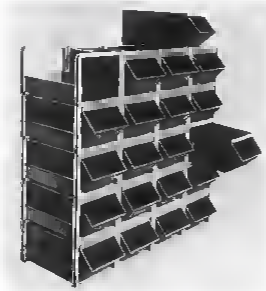
"Innards" of castings and welded parts can be radiographed with the truck-mounted X-ray machine of General Electric Co., Schenectady, N. Y. With this model OX-220 concealed flaws in metal can be detected before machining operations begin. The machine is rated at 75 to 220 kilovolts peak at 10 ma. It is completely shockproof, all high voltage equipment including x-ray tube and transformer, being oil-immersed in grounded metal case. Control panel is mounted in lead-lined booth to protect operator. The machine weighs 7,000 lb. and its rays will penetrate about 3½ in. in steel—AVIATION, *March, 1941*

Featuring a colored sector dial and precision movement with Tobin bronze bushings and monel metal pivots to reduce bearing wear to a minimum, a new oil temperature gage is offered by the Air-Safe Instrument Co., Los Angeles, Calif. Available in four models with Centigrade or Fahrenheit reading scales and 6 or 12 ft. capillary tubes, the Air-Safe oil temperature gage is mounted in a standard AN size case with 1⅞ in. diameter dial. The colored sector feature is mounted around the rim, separate from the dial proper. This provides the pilot with maximum speed of instrument interpretation, as a single glance will tell if the needle is in the operating range or in the danger zone, and detailed reading is usually unnecessary—AVIATION, *March, 1941*

A new aluminum ladder, designed to increase speed and safety in refueling large passenger planes, has been introduced by the Aluminum Ladder Co., Tarentum, Pa. Made entirely from Alcoa aluminum alloy 61ST, it is extremely light, yet strong enough to support the heaviest workman. Non-sparking, it will never rust or otherwise deteriorate. Rungs are of ¾ in. round corrugated aluminum, with a top step made from aluminum treadplate, 7½x12½ in., to prevent workmen's shoes from touching the wing surface. Suitable lengths will be supplied for different types of planes—AVIATION, *March, 1941*

Latest thing in armorplate for aircraft is the new lightweight "Colalloy Armorplate" reported by Colonial Alloys Co., Philadelphia, Pa. Weighing about ½ that of steel of the same size and thickness, "Colalloy Armorplate" has a surface hardness ranging up to 1000 Brinell and is not brittle. It is said to resist penetration caused by frictional heat, having a rate of heat dispersion several times greater than steel, a glossy smooth, corrosion-resistant surface, and a marked tendency to resist ice formation. Heat treating or expensive equipment are unnecessary for the material which can be supplied in many forms—AVIATION, *March, 1941*

With millions of square feet of new factory space being added to aircraft production facilities, equipment such as the new Roto Sweeper developed by the Ideal Power Lawn Mower Co., Lansing, Mich., is sure to meet with wide acceptance. The Ideal Roto Sweeper assures better and quicker work than several men with hand brushes or brooms, sweeping an average of 36,000 sq. ft. of floor area per hour. The sweeper works equally well on concrete, wood, tile, brick, or asphalt floors. It picks up dirt, dust, sand, gravel, iron filings, borings, chips, cinder, paper or commercial sweeping compound. A sprinkler is provided to keep the brush bristles moist and prevent raising of any objectionable amount of dust. Power is supplied by a small gasoline engine. For long stretches of straight sweeping a riding trailer may be provided for the operator, materially speeding his work.—AVIATION, *March 1941*

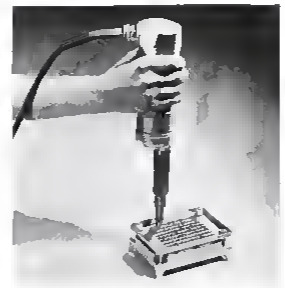


Stackbin Corp.'s Stackbins-in-Stackracks

General Electric portable X-ray equipment

Air-Safe temperature gage

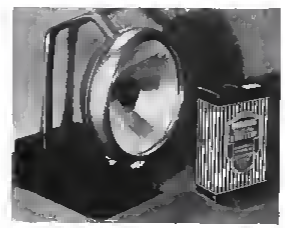
Ideal Roto Sweeper



Independent Pn. Tool "Pix Up" Finder

Lear Avia Model TRM-204

Wetzler hand clamp



Burgess portable lantern

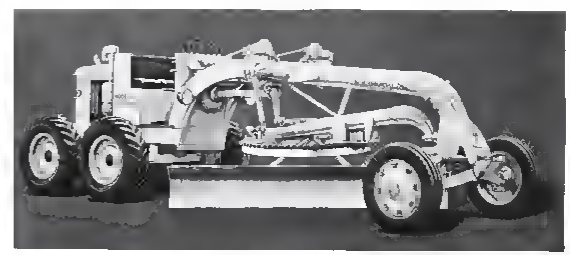
Fumbling fingers are eliminated on power screw driving operations by the Thor "Pix-Up" Finder and Adjusto-Tray designed for use with all Thor portable power screw drivers, pneumatic and electric, manufactured by the Independent Pneumatic Tool Co., Chicago, Ill. The Adjusto-Tray is a screw-holding tray with a series of longitudinal slots in the bottoms. A quantity of screws placed in the tray is quickly shaken into position in the slots. Then a power screwdriver equipped with the "Pix-Up" Finder is placed over a screw head and pressed down so that the Finder grasps the screw head as the tray is depressed slightly. The operation is entirely mechanical. Application of the equipment to certain aircraft assembly operations has increased production from three to nine times over previous hand methods of starting screws.—AVIATION, *March, 1941*

A new two-way portable radio is announced by Lear Avia, Inc., Dayton, Ohio. Designated as model TRM-204, the unit provides a definite means of communication between ground station and aircraft in flight. The transmitter, master oscillator type, has an output of 10 watts in the 3000-6000 Kcs bands into an optimum antenna. Any frequency within the transmitter's range may be crystal controlled by an externally attachable crystal. The power supply unit for both transmitter and receiver is a special type dynamotor housed in the bottom of the carrying case, measuring 12x6¼x12¼ inches. Weight of entire unit, including all accessories except the storage battery, is 20 lb. 15 oz.—AVIATION, *March, 1941*

A quick-acting hand clamp which has proved highly satisfactory for pulling skin section tight to the frames of aircraft fuselage assemblies is offered by The Wetzler Clamp Co., Long Island City, N. Y. Used in conjunction with 2-in. canvas bands, these clamps are widely applicable to aircraft assembly operations both of wood and metal. The clamps pull metal parts in place for riveting, and may be used in place of individual clamps for many wood gluing operations—AVIATION, *March, 1941*

Looking like an automobile spotlight, and weighing only 4¾ lb., the new portable lantern developed by the Burgess Battery Co., Chicago, Ill., has 180,000 cp. The light was designed for emergency uses where safe, bright lighting is required. In a novel test conducted by two pilots the light was seen from a distance of 55 miles; at 100 ft. it has 18 foot candles, which is equal to the average office illumination.—AVIATION, *March, 1941*

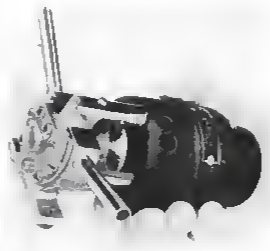
Greater earth-moving capacity is claimed for the new Model "AD" Motor Grader made by Allis-Chalmers Mfg. Co., Milwaukee, Wis. With the pressing need for additional airports, this 21,500 lb. model is said to have more power and greater capacity than any other motor grader, just the machine where a quick grading job is required. The Model "AD" is powered by a 75 hp. 2-cycle Diesel having a power stroke on every down stroke of the piston, thus delivering as much power as a 4-cycle engine twice its size. The full volume of dirt is permitted to roll off the blade without hanging up under the front axle and circle through an exclusive feature, the "Hi-arch" front axle with 22 in. clearance. The grader has a range of six forward and three reverse speeds and with throttle control forward speeds from 1.48 to 16.6 m.p.h. and reverse speeds from 1.75 to 6.15 m.p.h. can be selected at will.—AVIATION, *March 1941*



Allis-Chalmers Motor Grader

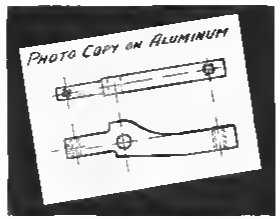
Harvey Wells lightplane receiver

Especially designed for light aircraft use a new radio receiver has just been placed on the market by Harvey-Wells Communications Inc, of Southbridge, Mass Said to incorporate the latest advances in aircraft radio engineering, the design is based functionally on actual requirements of private aviation as found through flying experiences of Harvey-Wells personnel This compact model, Type AR-2-A, 4-tube receiver weighs only 9 lb complete with heavy duty batteries, battery case, cables and headphones The receiver cabinet measures only 6x4½x4 in and is furnished with Universal shock mountings so that it may be mounted in any number of positions in the ship—AVIATION, *March, 1941*



Eastern Model UT Midget Pump

A new midget positive pressure pump has been announced by Eastern Engineering Co, New Haven, Conn, makers of a growing line of midget size pumps Useful for any application in which location of tanks and containers make self priming essential, the new pump, designated Eastern Model 'UT", has a maximum pressure of 35 lb p s i and a maximum volume of 3 gal per min Of rotary type, it is 6x3x2½ in and weighs 3½ lb Power is supplied by a Universal fan-cooled motor operating on a c or d c Its light weight and small size make it particularly adaptable to all installations requiring the pumping of thin liquids where weight and space involved must be kept at a minimum—AVIATION, *March, 1941*

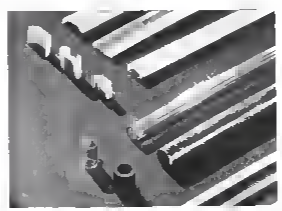


Republic Engr Prod. Photo Sensitized Metal

One of the most interesting of recent developments for speeding up aircraft production is a new process called Photo Sensitized Metal made by Republic Engineering Products, Inc, 480 Lexington Ave, N Y C This new, sensitized, aluminum-base metal is said to be safer and more convenient than paper or cloth in the shop, and ideal for making exact copies of photographic plates and instruction sheets The usual steps of development and fixation following the processing of ordinary film is recommended Distortion, due to unequal expansion and contraction commonly present in sensitized film, paper or tracing cloth, is entirely eliminated Sizes up to 5x10 ft can be supplied on special order—AVIATION, *March, 1941*

Racine 2-button Multichron

Timers and chronographs are always useful in aviation and when an instrument performs four important functions it assumes the nature of indispensability The new double-button Multichron, Style No 230/7B, recently introduced by Jules Racine & Co, 20 W 47th St, N Y C, can be used as a timer, watch, tachometer, and a telemeter to indicate distance of light and sound Equipped with a 45 min register the new 2-button model affords a time-out feature Pressure on one button consecutively starts, stops and again starts the sweep second hand. Pressure on the other button brings the sweep hand back to zero The mechanism is a 15-jewel Gallet movement—AVIATION, *March, 1941*

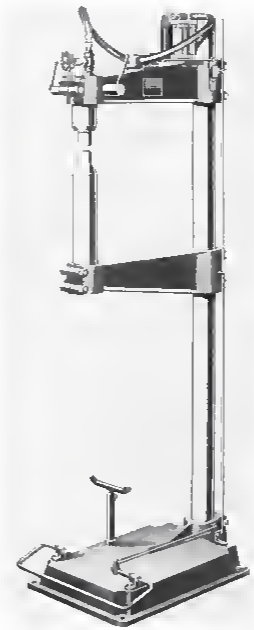


Detroit Macoid extruded plastics

A bright future seems to be in store for plastics, which is rapidly becoming a major industry Latest development is the perfection of a new process for making plastic molding strip and tubing rods in continuous lengths Detroit Macoid Corp, Detroit, Mich, in announcing the new method, report that their extruded plastics are obtainable in a wide assortment of colors in either opaque, translucent or transparent forms Advantages claimed for the Detroit Macoid process are economy, smooth lustrous finish, low heat conductivity, and imperviousness to changing climatic conditions—AVIATION, *March, 1941*

Ingersoll-Rand "Multi-vane" drill

Two new additions to its "Multi-vane" drill line—sizes 00 and 0—have been announced by Ingersoll Rand Co, Phillipsburg, N J Extremely light, ranging from 1½ to 2⅞ lb, numerous attachments can be furnished to adapt these tools



Selden Pn Planishing Hammer

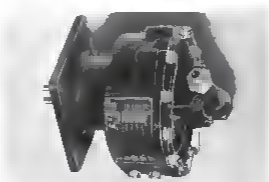
for light screw driving, nut running, close-quarter drilling, wire brushing, sanding, etc Straight, lever throttle, or pistol-grip handles are available.—AVIATION, *March, 1941*

To hammer out the wrinkles in National Defense Selden Pneumatic Tool Co, Jackson, Mich, are manufacturing model SFH18 12, smallest of a series of pneumatic planishing hammers A high speed machine for finishing sheet structural shapes this hammer also makes an efficient riveter for light riveting by installing the proper shaped dies Having a speed varying from 4- to 8000 oscillations per min, its stroke can be adjusted from a feather touch to a blow heavy enough to shape and form 18 gage steel. A foot control permits the operator to start and stop the hammer instantly, power and speed control valves are located directly over the cylinder An important feature lies in the fact that the hammer bracket and die support bracket can be raised or lowered to meet operators requirements—AVIATION, *March, 1941*

How to get into a tight corner is illustrated by Blue Point special production drills made by Snap-on Tools Corp, Kenosha, Wis These light, compact, all ball-bearing tools of ⅜ to ½ in drilling capacity have an overall length of 7½ in and a body diameter of 3⅜ in A grip handle is centered below the body of the tool for easy handling Helical gears are precisioned machined for quiet operation and long life, motors are universal for d c or a c up to 60 cycles, with a full load speed of 2100 r p m for the ⅜ in drill and 1300 for the ½ in drill Special speeds and voltages are also available.—AVIATION, *March 1941*

Snap-on Corp s Blue Point drill

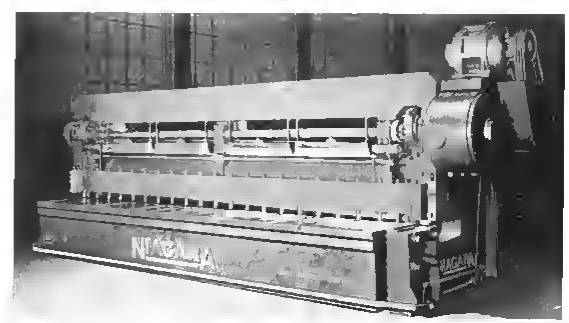
A light and simple hydraulic system for the operation of airplane equipment, such as flaps and landing gear is manufactured by the Dowty Equipment Corp, Long Island City, N Y Called the Dowty "Livelme" engine driven pump, the unit is designed to incorporate its own pressure regulator and can develop high operating pressures a combination which is said to make it of particular value for pursuit ships—AVIATION, *March, 1941*



Dowty Livelme Hyd. Pump

Newest arrival in the family of streamline continuous Blueprinting Machines, made by C F Pease Co, Chicago, Ill, is model "22-16" This combination consists of a model "22" Printer in conjunction with a model "16" Washer and Dryer The "22-16" produces uniform, contrasty prints with clean-cut, sharp lines at exceptionally low cost per sq ft—AVIATION, *March, 1941*

Addition of a new power squaring shear, No KL-18, having an 18-foot cutting length and capacity of ⅜ in mild steel is announced by Niagara Machine & Tool Works, Buffalo N Y Equipped with a quick-setting, self-measuring ball-bearing, parallel back gage, adjustable to increments of 1/128 inch, the shear is controlled by means of a 14 point clutch operating in a bath of oil All gear drives are mounted on anti-friction bearings, and enclosed in oil-tight case Toggle operated, independent spring pressure foot hold-down provides a smooth and firm grip on sheets of varying lengths—AVIATION, *March, 1941*



Niagara Power Squaring Shear KL-18

THE AVIATION NEWS

BLAINE STUBBLEFIELD, Washington — C. F. McReynolds, Pacific Coast — Jay P. AuWerter, New York — E. R. Lockin, New York

MARCH 1941

Top Defense Authority Shapes Organization Duties and Functions are Further Clarified

Washington (AVIATION BUREAU)—Gradually the Office of Production Management is spreading out the nucleus of experts which it took over from the old Defense Commission, expanding into a working organization with fairly definite duties and definite authority. Typical is a group concerned with aircraft which is expanding from 8 men to 75. (For OPM personnel detail, see page 32)

Eventually it may well work out that the whole procurement problem—the industrial side of defense—is placed in civilian hands, that the Air Corps will ask for so many of such and such a plane, and OPM will take over from there. This is not yet the case. OPM is on a trouble-shooting basis. The normal flow of getting material — design, contract award, inspection, delivery—is still in the hands of Army and Navy.

But whenever a difficulty arises—a problem as to who should get a contract, a decision on the type of tooling to be adopted, a shortage of raw materials — OPM steps in. And when it finds a practice or a situation which is causing the trouble, it has the authority to do something about it.

Internal organization of OPM is much tighter than that of the Defense Commission. Under the top board (Knudsen, Hillman, Knox, Stimson) are three divisions: production, purchasing, and priorities. A division of labor may be added.

Heading the production division is John D. Biggers, president of Libby-Owens Ford Glass Co., with William L. Batt, of SKF Industries, as his deputy. This division combines the functions of the raw materials and production divisions of the Defense Commission. Giving immediate attention to the problems of industrial raw materials, under Biggers, is Averell Harriman of the Union Pacific R.R. Of chief aircraft importance are the metals, on which George M. Moffett of Corn Products Refining Co. reports to Harriman.

Production of goods where the chief problem is finding adequate capacity is placed in charge of E. F. Johnson, chief of aircraft, ordnance and tools. Johnson is a former vice president of General Motors. Under Johnson, Merrill C. Meigs, publisher of the Chicago *Herald American*, is in charge of aircraft. Mason Britton, of McGraw Hill, continues in charge of tools.

The special problems of airplane production clearly come in pretty far down on the organization chart; Meigs reports to Johnson reports to Biggers reports to Knudsen and Hillman. It is this—plus division of authority between Army and OPM—which has given rise to agitation for appointment of a "czar of aircraft" outside the OPM organization.

The conspicuous fact that most of these men have been appointed to fields outside their normal activity is not an accident. Intention is to avoid situations in which men have to set policies affecting their own and their competitor's business.

A slightly different approach to this last problem has been taken in the priorities division. Under Stettinius and his deputy, A. C. C. Hill, the division is divided into five sections corresponding to the various classes of items on which priorities may become necessary—minerals and metals, commercial aircraft, tools and equipment, chemicals, and general products. These sections are being given a dual leadership, an impartial "executive" from outside the field is in charge, while associated with him is an expert "administrator" who knows the field thoroughly. Thus Dexter S. Kimball, former dean of engineering at Cornell, is executive for tools and equipment, while Ralph E. Flanders of Jones & Lamson Machine Co. is his administrator.

Arthur B. Whiteside, of Dunn & Bradstreet, is executive of commercial aircraft priorities, working with the committee set up under the Defense Commission.

Within each section committees are named to advise the executive of the problems of particular items on which there is a possibility priorities will be needed. Typically, these committees consist of representatives of the producers, of industrial customers, of the Army, and of the Navy. An exception is the committee on aluminum and magnesium which contains no representative of Alcoa.

Legal power to issue compulsory priorities vests in Stettinius' division. So far most ratings are being issued by the Army and Navy Munitions Board, but all this work may soon be taken over by OPM.

ARTIST'S MODEL of new engine research laboratory now being built for NACA at Cleveland airport. New lab. is to cost over $8,000,000 and will be third major research station for NACA. Dr. George Lewis and General Brett broke ground.

Keith T. Pitch

NEW BRITISH BOEING B-17C'S at Vancouver, British Columbia, reportedly en route to Gander Lake, Newfoundland, before flying the Atlantic to England. Notice the flush blisters on the sides, also that this model does not have a gun turret in the tail.

Expect Request for Airport Expansion Fund
220 Ports in Works; Gorrell Asks Zoning Law

Washington (AVIATION Bureau) —Request to Congress for $150,000,000 in addition to the $40,000,000 already allocated to the 200 airport program of the Civil Aeronautics Administration was being anticipated as this was written. It was assumed that the 50 projects already approved by Army and Navy, in addition to the 200, would be included. The President's budget recommendation calls for $33,000,000 for completion of the total 250.

Unofficial observations are that federal agencies disagree on the question of an fields. Critics say that the Army is not sufficiently interested to wear out its welcome with appropriations committees by asking for money for its own field program. At the same time Army is moving in on civilian fields. Criticism of the Services on such points is always shaky, because the critics rarely have complete information.

Meanwhile, Gen. Donald Connolly, Administrator of Civil Aeronautics, stated that all 200 of the airports vitsl to defense will be in the construction phase by mid-February. All of the contract projects will heve been advertised by regional managers of CAA under the decentralization policy which has been adapted to speed completion.

The 200 sites have been approved by the Secretaries of War, Navy and Commerce. Most are close to U.S. boundaries for strategic reasons. While these airports are mostly improvements of existing facilities, and while they are mostly on the airway system and era therefore valuable to civil aviation, the primary consideration is their value to defense.

This is the first appropriation ever made directly to the civil aviation agency for airports. Approximately $200,000,000 have been spent by the government on airports since 1933, mostly through public works and relief agencies. The present program was the first step following a recommendation by CAA to Congress that anr present 2,300 fields be increased to 4,000 at a cost of about $500,000,000.

Col. Edgar S. Gorrell, for the Air Transport Assn., recently recommended an airport and improvement plan he carried out at a cost of $500,000,000, but he stated that disputes among federal leaders are delaying progress. He maintained that laws alresdy on the books authorize the expansion, that only the appropriations are necessary.

Colonel Gorrell pointed out that no agency of the Government has the power to zone airports against obstruction hazards. He cited control of waterway hazards by the Secretary of War and by other means as an example, and he urged investment of such powers in the Administrator of Civil Aeronautics. He praised the CAA's model state zoning bill as a step in the right direction.

The National Aviation Training Assn., advocating support of Civil Pilot Training, points out that the Nation's airport system is being improved by CPT, which has converted scores of weed-grown airports into "busy little air centers," at no cost to the Government.

CAA has published a volume reporting results of a five-year study of wind and climatic conditions existing during periods of restricted visibility at 182 airports throughout the country.

Rep. Maas Proposes Naval Air Districts

Reporting on an 8,000-mi. inspection trip of aircraft factories and Naval bases, Rep. Melvin J. Maas (R., Minn.), ranking minority member of the House Naval Affairs Committee, suggested a study of the advisability of removing Naval Air Districts from the jurisdiction of naval district commandants and establishing naval air districts directly under the Bureau of Aeronautics.

Maas also recommended that educational requirements for aviation cadets be lowered; that a new Marine Corps base be established to supplement Quantico, San Diego and Parris Island, and that deliveries of new planes to the fleet be expedited to release more service-type ships to the training centers. The Congressman expressed approval of the progress on construction of new air stations but anticipated that additional funds would be necessary to complete the new facilities.

THE SIGN TELLS THE STORY. These basic trainers are really rolling out of the Vultee plant this wintar.

Inerease of CPT 1942 Budget is Urged
Air Corps Takes No Offieial Position

Washington (AVIATION Bureau) —A strenuous effort was being made at this writing, by friends of the Civil Pilot Training Program, to have the Appropriations Committee raise the fund for fiscal 1942 to something above the $18,000,000 recommended by the Budget Bureau. Among proponents for CPT are the National Aeronautic Assn., the National Aviation Training Assn., many Congressmen fans and private flyers. The Civil Aeronautics Administration, which has charge of CPT, is not permitted under the rules to argue for any more than is set up in the Budget. Last year's fund for pilot training was $37,000,000.

If the $18,000,000 budget is not increased, it will provide for the training of about 30,000 students in primary and 6,000 in secondary, according to NAA. These could be put through in two classes rather than three.

Jesse Jones, Secretary of Commerce, reported that 2,600 trainees already are training in the Army and Navy. Airlines are beginning to draw on CPT graduates; during the past year, they took 167 CPT instructors. Boeing School has 65 secondary graduates.

The Aviation Training Assn. says that the budget was cut because too few among officials and the public know of its accomplishments. But back of that is the more significant fact that anthorities in charge say that the Army and Navy caused the ent to be made.

As this was written Air Corps officers were nnwilling to take any position for or against CPT. They made it clear that the value of civil training is fully appreeiated. Air Corps can use civil trained pilots up to a certain proportion of total trainees; beyond that it wants to concentrate on its own men, under full military discipline and day-after-day drill. In other words, there is a limit to which part-time military training can be of valua. It seemed probable that AC would neither support nor oppose an increase in the budget.

Must Report Aeeidents

Civil Aeronautics Board amended the Civil Air Regulations, requiring immediate notification of the Board of the Administrator of Civil Aeronautics in esse of any serious civil aircraft accident. Detailed instructions are also given as to the rules for preservation of wreckage and the conditions under which its removal will be approved.

Any airline accident or acelent resulting in serious or fatal injury to any person, or any accident known or believed to have resulted from a structural failure in flight, is included as a "serious" accident. In the case of non-air carrier accidents, the pilot is responsible for the notification "in person or by cable, telegraph, telephone, or radio", but if he is incapacitated, the owner or lessee or any other person who authorizes the operation of the aircraft is charged with notifying the authorities. In the case of airlines, the company is responsible for the notification. Pilot owners must write a report of the accident on forms which are supplied by the CAB and submit to the nearest branch office of the CAB.

Spot Checking

8-17D Flying Fortress, an improved model of Boeing B-17, is being tested by the Air Corps; has four 1200 hp. engines; weighs 38,287 pounds.

19,000 CPT trainees—15,000 in primary and 4000 in secondary, are being initiated into the third session of 1940–41.

Air Travel Credit on 17 leading airlines become effective March 1. It is same as that in effect on some railroads.

Air express shipments passed the 1,000,000 mark in 1940, the largest one-year total in REA's air history.

Coast Guard gets appropriation of $25,000,000; includes funds for 17 new amphibians.

Seven Consolidated Patrol bombers had been ferried to England at this writing. Bernt Balchen, Clyde Pangborn and others are tripping the Atlantic.

Balloon barrages are being tried by the Army at Fort Lewis.

Links to Alaska will be established by Canadian airlines through Alberta and British Columbia, for defense.

Precision cross country for instructors is being taught by the airlines in cooperation with CAA. Instructors are for CPT program.

Air Line Pilots Reserve has been proposed in a bill introduced by Sen. James M. Mead of New York.

Naval Aero Academy in San Diego is proposed in a bill by Rep. Izac of California.

Automatic block signal system for planes in flight has been perfected by TWA.

Six miles per gallon is approximate fuel consumption at Randolph Field.

W. T. Grohom, formerly manager of Tubular Goods Division, A. O. Smith Corp., is now acting Factory Manager with Fleetwings. F. A. Coriell is Chief of Production and Planning.

First six of a group of 200 rated flight instructors reported to Northwest Airlines pilot training school for two weeks precision cross country. Course will also be given by Boeing School at Oakland. The instructors are for CPT cross country training this spring.

"Foeeral parties accommodated; real German cooking." An old hotel bearing that sign was pulled down at Farmingdale to make room for the new Ranger Engine plant.

SAE aeronautic meeting, Washington Hotel, Washington, D. C., March 13–14.

Pan American's application for amendment of certificate, permiting extension from Manila to Singapore, is recommended by CAB examiner for approval by the Board.

British Request Seereey

British purchasing officers have advised at least one West Coast manufacturer as to what information should not be disclosed. First, they want to avoid mention in the press of shipping or fly away points on the East Coast, including routes by which planes are flown to final destination. Mention of range, bomb load, and armament is also on the QT.

U.S. RAF Asseciation

Royal Air Force Assn. of the United States has been established at 333 North Michigan Ave., Chicago, chairmaned by Harold McGrath. Over 4,000 Americans served in the RAF during World War, the First. Hundreds died and many won British decorations. Among them: Clayton Knight, Vernon Castle, Jimmy Parker, George Spaulding, Tom Powers, Jack Vennell, Art Langtry, Jack Benson, Fowler Barker, Carter Harmon, Canfield Cook, Boaks Carter, Howard Board, "Cap" Herne, Harold McGrath, Loren Asley, Guy Findley, Bill Jakes, Dick Carlin. The roster of the new group is growing rapidly. Headquarters is called the "Air House." The forty-ish oldtimers are going to help the boys of the RAF in any way they can.

Kelly to San Angelo

A permanent change of the 64th Air Base Group (special), the 67th School Squadron and the 68th School Squadron from

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Tkey Are Saying "Airerahft"

The Stubblefield award this month is divided among the few remaining combat plane manufacturers who haven't built the world's fastest job.

President Roosevelt, with his new high in popularity and his emergency powers, from now on can do practically as he likes with civil aviation in the interests of defense.

Much more argument than ever before now goes on behind Washington technologists, doors about the relative merits of liquid- and air-cooled engines.

Germany's problem, before the fall of France, was to get control of land and they built their planes accordingly. Now they want to control the air which is a new and yet-unsolved problem. Incidentally the Nazis can no longer terrify the enemy with shriekers and mere noise.

German air strength was recently estimated by a high authority who, newsmen said, was no less than Chief of Staff General George Marshall. 18,000 ships on the line and 18,000 on reserve British press office also makes total 36,000 but puts 24,000 of them on the line.

Air power vs. sea power argument will not end till some future decisive battle ends it. While U. S. experts disagree, all admit thet for the $50,000,000-price of a cruiser you can buy about 750 dive bombers. But Germany still admits that surface control of the sea can rule the world.

Some of the boys who are defending the nation in Washington have inhaled so much British atmosphere that they are saying "airerahft" when they mean airplane.

Army is on instruments, now, much more than ever before. Most Air Corps instrument work is done on bombers and transports. Blind control of light combat craft is touchy business.

Air Corps is operating increasingly on the airway radio beams, and men who ought to know say that the Government may soon find it necessary to move into certain coordinating jobs on the civil air terminals.

Moonlight and roses are gone again. CAA was re-organized to get rid of Air Safety Board trouble. Now, CAB finds the Administrator at fault in the Salt Lake accident. What this country needs is some new kind of officials who will like to take the blame for accidents.

Not long ago Sir Hugh Dowding, once chief of Britain's air defense, said that by Spring England would have perfected a means of slowing down night raids by the Germans. From London now come reports that a lightning calculator has been developed to compensate for the aiming error, due to elapsed time before sound of enemy craft reaches the detector. It seems possible this is the solution mentioned by Dowding.

Dean of all airline pilots is Jack Knight, veteran of the old Post Office transcontinental line, then of Boeing, and since with United Air Lines. He flew the first night mail, between North Platte and Chicago, on the night of February 22–23, twenty years ago. This trip had been an overnight train bookup. Following a chain of bonfires lighted by farmers, Knight proved that the job could be done, sold the idea to Congress, which made the appropriations that started the present system of 27,000 miles of lighted airways. The Windsock fires 21 guns for Jack Knight.

Kelly Field to San Angelo, Texas, is being made. Advance detachments will be approximately 100 enlisted men and one officer. The three units have a total strength of about 1,000 officers and enlisted men.

NAA Liquidates Debts Improves News Letter

National Aeronautic Assn., under the leadership of Col. G. de Freest Larner and Gill Robb Wilson, is taking an increasingly active part in the aviation affairs of the nation. The association's counsel is receiving consideration in all the federal and other agencies concerned with aircraft and flying. More and better information is going into the regular Washington News Letter, which is now edited by Kendall Hoyt, an experienced Washington journalist and aviation writer. Since June 1940 NAA has paid $5,600 in debts and has a substantial balance in the bank. All employees have had much-needed salary increases of 10 to 20 percent. Mail postage per month increased since June from $245 to $545. Membership increased 25 percent.

PFA Plans Peace Day

"P Day" is Peace Day, as the Private Flyers Assn. puts it, and that day will bring trouble, the officers believe. A throng of demilitarized pilots will come home, a vast potential market for airplanes. But they will meet up with so much inconvenience, red-tape, and expansa, that they will quit flying, as the average pilot did after two or three years, ever under conditions of the recent past. The association believes that a post-war airport system, for the airlines only, will add to their troubles. But it proposes to carry on. Its policy: (1) A practical "united front" with other interested organizations, (2) support for a "Civilian Air Reserve", (3) creation of a "P Day" plan for private flying, (4) continuance of the PFA Bulletin as an adjunct to the three other objectives.

27,807 Hours Aloft

Latest reports on pilot training at Randolph Field disclose that 850 flying cadets are getting 70 hr. aloft each in the ten-week basic training course. Flying time broke all previous records when Randolph Field planes covered almost 4 million miles in 27,807 hrs. during the month.

Calling Names

W. A. Patterson, United Air Lines president is named a member of the board of directors of the Chicago Association of Commerce.

Perry Thomas is advertising assistant at United Air Lines. Was previously with N. W. Ayer & Son.

Marion E. Crews for past two years chief of CAA's Midwest Aircraft Airworthiness Section at K. C., is promoted to chief of CAA Airworthiness Section, Bureau of Safety Regulation, Washington, succeeding Jack Cross, who goes with Aeronautical Chamber of Commerce.

R. P. Brinkley of Pennsylvania Central is made assistant traffic manager in charge of station sales with headquarters in Washington.

David F. Tods is appointed industrial traffic manager, also at Washington.

Kenneth Faute joins Drake Manufacturing Co. as sales engineer.

Gaston Marque resigns as aviation editor of Wall Street Journal to handle public relations for Pennsylvania Central Airlines at Pittsburgh.

H. W. Anderson, heretofore chief of Air Carrier Inspection Service of CAA, heads up aviation department for Whiting Corporation, Harvey, Ill.

William C. Mentzer, chief engineer of United Air Lines, becomes director of engineering in charge of all engineering research, maintenance, overhaul and servicing.

L. E. Osborne, manager of manufacturing and engineering for Westinghouse Merchandising Institute, is granted leave of absence to join staff of the Defense Commissioner's Office of Production Management.

Capt. H. J. Horsey, founder pilot of Imperial Airways, died on January 2 as the result of accident while ferrying military aircraft for Britain's Air Transport Auxiliary.

Brig. Gen. Frederic E. Humphreys, first Army man in the world to fly solo in a military airplane (Oct. 26, 1909), and who in 1918 was head of the department of practical airplane design at M.I.T., died of pneumonia on Jan. 20 at the age of 67.

James H. Doolittle, Jr., 20, son of the Jimmy Doolittle, has been placed on the eligibility list for appointment as an Army Flying Cadet.

Robert J. Smith, Braniff Airways v-p, addressed the Institute of the Aeronautical Sciences on Jan. 30 on economic and technical aspects of air carrier regulations.

R. W. Tomlinson, v-p in charge of engineering for TWA, is voted Kansas City's outstanding civilian figure of 1940 in recognition of his substratosphere experiments, receiving a plaque from the Kansas City chapter of N.A.A.

O. W. Sellerling, v-p and treasurer of Sellerling Rubber Co., is honored by entire company at party celebrating his 60th birthday.

James F. Towers is designated assistant director in charge of administration by E. K. Slettinius, Jr., director of the division of priorities of the Office of Production Management. Mr. Towers is executive vice president of Ford, Bacon & Davis.

T. S. Sowsky is appointed district traffic manager for Northwest Airlines in Rochester, Minn., in charge of newly created Southern Minnesota territory for the system.

I. Ae. S. Honors Given at New York Meeting

GLENN L. MARTIN received the distinguished Continental Daniel Guggenheim Medal for contributions to aeronautical development and the production of many types of high performance aircraft.

MRS. BELLA C. LANDAUER of New York City who has generously presented the Institute of the Aeronautical Sciences with a rare collection of aeronautical art and music.

O. B. Smith, American Airlines president, is the subject of a leading article in the Feb. 1 issue of the Saturday Evening Post. Swell reading.

George B. Hotch, S. B. Newman, Raymond E. Peterson, and W. R. Thigpen are new district traffic managers of United Air Lines at Chicago, Los Angeles, Milwaukee and Portland respectively.

J. A. McAvoy promoted from auditor to assistant treasurer of Pennsylvania Central Airlines, pioneered a new cost analysis system adopted by the line.

Sterling S. Smoker, 26, of PCA took his first train ride to the end of the locomotive of the "Hiawatha".

R. C. Wilson, Capt., U. S. Army Air Corps, is publishing a booklet entitled "Preliminary Airplane Design".

The North West Aviation Planning Council will hold its 1941 meeting in Billings, Mont.

Gaston E. Marque, aviation editor of the Wall Street Journal has been appointed to the executive staff of PCA.

Russel F. Ahrens and **Homer J. Burkhart** appointed Eastern and Western sales managers, respectively, of UAL.

Oswald Ryan of CAB, appointed Assistant to the president of the Aeronautical Chamber of Commerce.

O. G. Grey, Aviation's correspondent in London has been bombed out of house and home by the Germans.

Dick Kirshbaum and Rod Leigh of the Aviation Writers Assn. write new Air Corps song "Wings to Victory".

Dr. Ralph T. Goodwin, appointed manager of Shell Oil's aviation department.

Jack Knight flew first night mail 20 years ago Feb. 22.

Marion E. Crews is appointed chief of CAA's airworthiness section.

Admiral Bieg, boss of the Atlantic fleet is the third naval officer to command a fleet, other two were Yarnell and Reeves.

DR. LOUIS H. BAUER of Hempstead, N. Y. recipient of the John Jaffries Award, presented at the Honors Night meeting of the Institute of Aeronautical Sciences.

DR. HUGH L. DRYDEN, Chief of the Mechanics and Sound Division of the Bureau of Standards, received the Sylvanus Albert Reed Award for contributions to aeronautics. Other winners were pictured in last months issue.

Two Federal Finance Plans for Defense Plants

Aireraft Manufacturers Seem Shy of Dwnership

Washington (AVIATION BUREAU)—Defense Plant Corp, an RFC subsidiary, is coming increasingly forward as the major means of financing plant expansion—displacing the Emergency Plant Facilities contract developed by the Defense Commission Outstanding examples are Studebaker's $50,000,000 plants for manufacture af Wright engines and Buick's $37,675,000 plant for Pratt & Whitney engines Orginally announced as EPF contracts, these are now being handled by Defense Plant

The two plans are similar in that under both the Army or Navy pays for the plant over five years, gets final title, and will then sell the plant to the manufacturer if he wants it. The EPF contract, however, provides that the plant be initially financed by bank loans, that the manufacturer hold title during the five-year repayment period, and that the government make a firm contract to meet the 60 monthly payments (which means that existing appropriations must be set aside for the purpose).

Under the RFC arrangement, Defense plant holds title during the five-year period and gets the money to build from RFC. The manufacturer rents the plant at $1 a year plus taxes and upkeep Moreover, since RFC is more trusting than a private bank, Army or Navy need not set aside money but merely agree to ask Congress to appropriate for the installment payments as they come due

For this reason Army and Navy prefer DPC to EPF Manufacturers also seem to like being free from any danger of difficulties which might arise from owning an arms plant

Major aireraft plant expansion jobs so far handled by Defense Plant Corp includes Bendix Aviation, $24,000,000, Consolidated Aircraft, $14,447,000; $58,500,000; North American Aviation, $10,000,000; Wright Aeronautical, $58,500,000.

Three Airship Bases

Construction of three lighter-than-air craft bases is planned by the Navy provided Congress releases the funds in the forthcoming annual Navy appropriation bill Authority to buy 48 blimps was approved last year

A special three-man commission, recently returned from a site inspection trip, is expected to recommend that the new bases, if acquired, be located in the San Francisco, Boston and Norfolk-Hatteras areas It is estimated construction would require 15 months from the time the money is made available

Alaska Base Progress

Brig Gen Reyhold, Acting Assistant Chief of Steff, reported to Congress recently that construction of the $12 million air base at Anchorage, Alaska, is already 85 percent complete, the $5 million air base project at Fairbanks 75 percent complete, although work began only last July Members of Congress who visited the site expressed themselves as "agreeably impressed" with this rapid progress

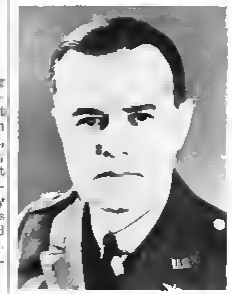
Navy Aviation Classes

Approximately 15 officers will be ordered to each of ten classes in heavier-than-air training at Pensacola during the fiscal year 1942 Candidates are invited to submit their applications to the Bureau of Novigation, Navy Department, Washington, not later than April 15, 1941 Each application is to be accompanied by a flight surgeon's endorsement as to physical condition

200,000 Flivver War

The U.S. could "blow an invading army to pieces" with an armada of 200,000 "flivver planes", in the opinion of speed ace, Col Roscoe Turnar, who proposes that the government buy up air lease all available small craft, provide airports and hire private flyers to form an aviation home defense corps

He contends that such planes could be effectively converted to military use and made capable of dropping a 100-lb or two 50-lb bombs from 1,000-1,500 ft. that production of these little ships could easily be stepped up to 200,000



Wide World

COL. IOWAL H. EDWARDS, newly appointed commanding officer of Randolph Field. With some 3,000 hours of flying time in his log book, the Colonel knows the answers on training.

Latin Air Bases

Rear Admiral John W Greenslade, who headed the joint Army-Navy Board that selected base sites on British Atlantic islands swapped for destroyers, revealed that the United States expects soon to reach agreements with Central and South American countries for American air and naval bases He said we are acquiring bases that command all sea approaches to our shores. In his opinion the United States does not need a base on Martinique, which is owned by France.

FIRST NORTHROP PATROL BOMBER at start of flight from Lake Elsinore, Calif., to Canada. Ship is powered with a 1200 hp. Wright, has a normal range of 1165 miles.

Chrysler Engine

President, K. T Keller of Chrysler Corp announces that company engineers have developed a 12-cylinder V-type liquid-cooled engine capable of turning out nearly 2,000 horsepower It was reported that the engine would use special high-test fuel, rated at 115 octane The army usually uses octane 90 to 100

Napier Saber

British Napier Saber engine is being considered for US production by Army and OPM Unofficial information is that this is a 2,000 h.p., plant with four banks of six cylinders. How much it has been flown, or how many units have been built, is not reported. It was presumed the engine is liquid-cooled, but this was not certain The high power rating is attributed by unauthorized observers as due to exceptionally high speed of 6,000 r.p.m.

Army and defense officials are considering all new water-cooled engine projects that show promise, but in each case they are taking into account the large problems and long delays that are sure to follow.

1000 Young Men

Secretary Knox of the Navy wants 1000 young unmarried men, age 20 to 27, with at least two years of college or equivalent Successful applicants will be enlisted in Naval Reserve for preliminary flight training Successful trainees will be appointed aviation cadets and ordered to full training courses Navy will operate three great flight centers Pensacola and Jacksonville, Fla., and Corpus Christie, Tex. Candidates may apply at any of the 313 Navy recruiting stations in the U S There are 13 Naval aviation reserve stations.

George S Warren is now vice president, charge of engineering for Bristol Aircraft. He formerly had identical job with Fleetwings Capt A L Petterson, remains president of Monocoupe and becomes v p in charge sales for Bristol, which will build plastic-bonded ships

Subcontracting Favored to Speed Production Organization of Pools Spreads Employment

Washington (AVIATION BUREAU)—Subcontracting or farming out of defense contracts is rapidly becoming regarded here as the panacea for expanded production that standardization of airplane types was last spring. However, indications are the current enthusiasm will get farther than did that short-lived proposal.

Largest scale example so far is the plan to have automotive plants make airplane parts on subcontract. Though extremely slow in getting underway, this plan has reached the point where a fairly definite program has been worked out by which the big three—Ford, Chrysler, G M—will make parts for some 300 bombers a month, themselves sub-subcontracting some of the work. This will doubtless be expanded as these firms gain experience, and there is already talk of drawing the smaller auto firms into a subcontracting program on engines and pursuit planes. Meanwhile Douglas has independently made contracts with auto body firms—Briggs and Murray.

Behind the push for farming out are two main motives. Growing emphasis in the administration on the necessity of large quick deliveries to Britain result in a desire to utilize existing manufacturing capacity of the country—even at the expense of the greater ultimate capacity and lower costs which can be achieved by the slower process of building new plants.

A second objective is to spread the employment resulting from defense around the country rather than concentrate it in a few armament boom towns. It is pointed out that 95 percent of the prime contracts so far have gone to 114 firms. It was this which led Hillman's labor division to take up the idea last fall and set Morris Cooke to working on it.

Cooke is still at work organizing local pools of small firms, which can take subcontracts as a unit and parcel out the work among their members. But meanwhile the services and OPM have seized on the idea as a production device. Army and Navy have each urged their contractors to subcontract as much work as possible, and OPM's production division has formed a Defense Contract Service to give technical help in this.

Heading up Defense Contract Service are Robert L. Mehornay, a Kansas City furniture dealer, and Joseph and Francis Trecker, Milwaukee milling machine manufacturers, who have established an outstanding subcontracting record. DCS has taken over and is reorganizing the system of local representatives in Federal Reserve Banks and branch banks which was set up some months ago by Donald Nelson's Office of Small Business Activities (of which Mehornay was deputy director). A production-minded man is being chosen and put in each of the banks to help in getting prime contractors and potential subcontractors together.

To aid them in their work a list of prime contractors has been compiled, broken down by federal reserve districts. Also a list of manufacturing firms which might be available for subcontracts is being compiled from the many surveys of capacity now underway.

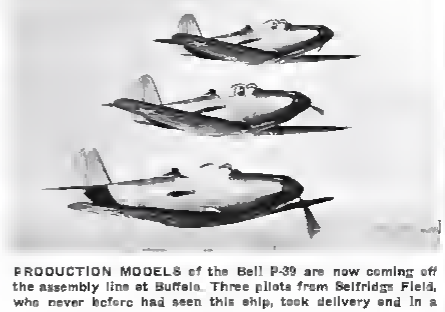
At the same time, DCS is working with Army and Navy on breaking down specifications and plans along natural subcontracting divisions. Thus, plans and specifications for an engine might be so drafted that the specifications for each part which could logically be farmed out would show on a separate sheet.

Buick to Build P&W Engines

A $51,000,000 plant to produce 500 engines a month will be built by Buick at Melrose Park, Chicago. New plant will be under government contract for production of P&W 1200 hp. engines and will employ around 10,000 persons with an estimated annual payroll of $17,000,000. Plans call for more than 1,000,000 sq. ft. of manufacturing floor space in which all parts and subassemblies will be produced and engines assembled. In addition there will be 24 test cells for engine testing, power house, personnel and administration buildings. Army contracts for aviation engines and parts will total about $94,000,000.

Thompson Aircraft products is building a new $11,198,000 plant, government-financed, at Euclid, Ohio for manufacturing engine parts.

BUICK WILL BUILD a $31,000,000 aircraft engine plant at Melrose Park, Chicago to manufacture P & W engines.



PRODUCTION MODELS of the Bell P-39 are now coming off the assembly line at Buffalo. Three pilots from Selfridge Field, who never before had seen this ship, took delivery and in a few minutes were doing close-order formation flying.

Recent Awards

Navy Department

Bendix Aviation Corp., Bendix, N. J., $462 520 for aircraft starters.

Brewster Aeronautical Corp., Long Island, N. Y., $4 544 287 for airplanes.

War Department

Denison Engineering Co., Columbus, Ohio, $495 000 for stand assemblies.

Wright Aeronautical Corp., Paterson, N. J., $241 537 for parts for Wright engines.

Bendix Aviation Corp., Bendix, N. J., $886 925 for assemblies.

Weston Electrical Instrument Corp., Newark, N. J., $143,534 for indicators.

Goodyear Tire & Rubber Co., Akron, Ohio, $923 504 for wheel and brake assemblies.

Lights, Inc., & Fritz Ziabarth, Alhambra, Calif., $613 695 for field lighting sets.

Bump Eng. Service Corp., Cleveland, Ohio, $2 629,793 for fuel and vacuum pumps.

Fairchild Aviation Corp., Jamaica, New York, $3 174 330 for cameras and equipment.

Beech Aircraft Corp., Wichita, Kansas, $1 191 838 for airplanes and parts.

General Motors Corp., Detroit, Mich., $36,497,520 for Pratt & Whitney engines and parts.

Continental Motors Corp., Detroit, Mich., $10 715 919 for engines and spare parts.

Air Cruisers, Inc., Clifton, N. J., $406 330 for cylinders.

Bendix Aviation Corp., South Bend, Ind., $168 269 for maintenance parts.

Weston Electrical Instrument Corp., Newark, N. J., $144 500 for thermometer indicators.

Fairchild Aviation Corp., Jamaica, New York, $387,475 for cameras.

Bell Aircraft Corp., Buffalo, N. Y., $249 375 for adapter assemblies.

Yale & Towne Mfg. Co., Stamford, Conn., $191 686 for fuel pumps.

Assembly Lines

By Robert Colborn

Two-thousand hp liquid-cooled engines are in the offing, but they aren't here yet. Allison is still a long ways from production of its big experimental job, hasn't settled yet between jeasing up what is substantially the same engine block or using a 24-cylinder X arrangement.

Rolls Royce, contrary to report, doesn't have a 2,000-horse job either. It does have a modification of the Merlin design which turns up some 1,400 hp. There is a very hush-hush British engine, the Saber, which is supposed to be in the 2,000 range, but it's not yet in quantity production.

Continuation of the liquid-cooled engine as a significant factor in U. S. pursuit plane programs is pretty much dependent upon development of a high-powered job. Until recently, official view has been that 1,000 liquid-cooled horses give about the same flying performance as 1,800-2,000 air-cooled, this is why three of the Army's four single-place pursuit types use the streamlined engine. Tendency towards a big poundage of armament has upset this equation—as has new skill in getting around "built in headwind" characteristics of the radials. High performance of the Navy's Vought fighter has been a shock to the Army.

Production problem on the 1,100-hp Allison has been pretty well licked. G.M. is turning out more of them than current production of P-40s and P-39s can utilize and is building up a backlog against the heavy demand which will come when Lockheed's twin-engine P-38 comes along.

Armament is distinctly behind plane production. The 37-mm cannon that goes on Bell's P-39 Airacobra is still almost a museum piece; less than a dozen have been installed on P-39s. The .50 caliber gun, likewise is still scarce and gets an even higher priority rating than engines; only Colt makes them so far (the British have none), though other sources are being developed. None of this is as much of a worry as you might assume because most of the planes go to Britain and are shipped unarmed.

Propellors you'll be hearing of soon as THE bottleneck.

Bottlenecks are always going to exist as long as we aim at capacity production. Something always sets the limit of capacity, and that's the bottleneck.

Airadio Inc., are successors to Airadio Co. with an enlarged plant for custom communications equipment.

Airplane fabric production is being expanded by Suncook Mills through more intensive use of available equipment and purchase of new looms.

Lawrence D. Bell, president and general manager of Bell Aircraft Corp., announces the following officers for 1941: Ray P. Whitman, first vice president, Omer L. Woodson, vice president and assistant general manager; Capt. Harry E. Collins, vice president in charge of export, Charles L. Beard, secretary and treasurer. J. F. Schoellkopf IV, sales manager. David G. Forman, assistant to the president, and Frederick R. Neely, Washington representative, were chosen assistant secretaries.

Output of planes, engines, propellors in 1940 was worth $544,440,000, Aero Chamber says. Plant floor space increased during the year from 7,410,000 sq.ft. to 12,665,000 for planes, from 2,211,000 to 5,272,000 for engines, from 393,000 to 846,000 for propellors. About 20,500,000 sq.ft. are under construction.

In units, output of military aircraft in January, 1938, was about 100, in January, 1939, about 200. In January of this year output ran about 800 units.

Combat types accounted for about 340 of these 800, trainers for 560. Newspaper accounts putting the proportion the other way around were wrong, Knudsen's tongue slipped. Engine production in January was about 2,400 units.

Workers in the aircraft industry will total more than a half million by this fall on the basis of present contracts, Labor Department estimates. This will make the industry almost the largest single employer of labor in the country. Biggest jump will come in May, when 44,000 will be hired.

Manufacturers who are expanding plant and want to amortize it for tax purposes within five years may now file application for a "Certificate of Necessity" any time within 30 days after starting construction. Before Congress changed the law, it was necessary actually to obtain a certificate before starting construction.

Privilege of five-year amortization is not confined to government contractors and subcontractors, any plant "necessary in the interest of national defense" is eligible.

Iridium price, running about $300 an ounce as compared with $148 last fall and $65 in 1939, is blasted as "due to sheer speculation" by Price Commissioner Henderson. He threatens to set the cops on the guilty ones. Iridium is used as a hardening agent for platinum in engine parts.

Doors of the Bell P-39 fall off when the pilot presses a lever near the instrument panel. Makes it easier to bail out.

Pratt & Whitney built its 25,000th engine early this year, having been at it 15 years. Purely by coincidence, the 25,000th was one of the new 1,850-hp. Double Wasps.

Boeing is just delivering the first of its six new clippers to Pan American, which will turn over the first two and another one to the British. They are the same as PA's present clippers except that 1,600-hp. Wright Cyclones are used, which, with an additional 1,200 gal. of fuel capacity, step up range to more than 4,000 miles.

Wage-earners in the aircraft industry are eligible to try for a $5,000 prize offered by Revere Copper & Brass for the production idea, not now in general use, which most helps to speed defense. Apply before April 30 to Revere Award Committee, Box 1805, Washington, D.C.

GEORGE C. RODGERS, sales manager of Curtiss Propeller Division of Curtiss-Wright, has been appointed management assistant. He will perform special duties for the general manager, including negotiations with the U. S. Government and the British Purchasing Commission.

EDWARD A. GILLIS, comptroller of Curtiss Propeller Division of Curtiss-Wright, was fatally injured in an automobile accident on Feb. 6th. He joined Curtiss Propeller Division in 1939 as auditor and was quickly promoted to comptroller of the unit and assistant treasurer of the corporation.

A FULL CARLOAD of 220 65 hp. Lycoming engines destined to power new 1941 Taylorcraft trainer and deluxe planes. Richard H. Depew, Jr., vice president of the Taylorcraft Aviation Corp., personally opens the door of the light plane industry's greatest single shipment of engines upon its arrival in Alliance, Ohio.

AVIATION ABROAD

On Schedule

By "Vista"

Last month this column dwelt fairly extensively on the fact that for the moment the Pan American Airways System was basing its future plans on large landplanes, and that an announcement could be expected shortly that a number of large landplanes in the 40 ton class had been ordered. Upon his return from Lisbon on the first survey flight of the new Westbound route of the Trans-Atlantic Clippers, Mr. Juan Trippe made a statement which bears out the correctness of this column's predictions, saying in fact that such planes had been ordered, but that for defense reasons he was not in a position to give further details.

International air traffic is thereby entering a new phase, in which we shall see landplanes crossing the oceans at high altitudes at far greater speed and with a greater factor of regularity than can be obtained at the moment with flying boats. Undoubtedly the experience of the British, who are negotiating to obtain T.W.A.'s five Boeing Stratoliners for a combination ferry and diplomatic line between England and Canada, will be invaluable, and prove that landplane service of the oceans is very well possible.

In 1938, when the first Stratoliners were in construction, there were plans that Pan American Airways would use them on a line to England, and possibly to Holland, where at that time the only base facilities for American planes were available at Schiphol. The war, and the tremendous development of the Latin American routes made it necessary that these airplanes, when they were finally delivered, were used on services to Buenos Aires and the Canal Zone, where need for faster, better connections was urgent.

In Canada, the C P R. is steadily acquiring more and more of the small, independent air services in the Northwest Territory, with apparently plans to eventually establish an alternate airline to the Orient via Alaska and Siberia. Such a route would thereby form the last link in the network of all English airlines around the world, a goal toward which British lines have been working for years, and which was stymied some years ago by American refusal to let a foreign airline use Honolulu as a base.

At the same time, Northwest Airlines is going ahead with its plans to connect the Midwest with Alaska, a service which has long been needed. They propose a 10½ hour service from St. Paul and Minneapolis to Fairbanks, via Fargo, Edmonton and White Horse, thereby making it possible to reach Alaska within 24 hours from New York.

The British are now operating 95% of their pre-war air mileage, by the last reports, maintaining connections between London and the Empire via Lisbon, where the K.L.M. DC-3s, under charter to the British, are now a familiar sight. From there, the service swings due South and then East across the center of Africa to Egypt, where connections are made with lines from South Africa, the Near and Far East and Australia.

American Export Airlines' transatlantic project received a setback when the House Appropriations committee struck out $1,229,736 from the Post Office bill, providing for mail payments. The argument was that the cost of new AEA service, as compared with proposed additional PAA trips, was not justified. But the cut still was to be passed on by the Senate as this was written. Meanwhile it was assumed that if AEA was denied the mail subsidy for any considerable period, Company would concentrate on its Latin American projects.

Unknown to many, the Italian airline LATI has been maintaining a landplane service between Rome and Rio de Janeiro during the past year and a quarter. This service now faces complete stoppage, including connections between Lisbon and Italy.

In recognition of his services as Administrator of Civil Aeronautics, **COL. DONALD H. CONNOLLY** has been promoted to the rank of Brigadier General. Gen. Connolly is also a member of the N.A.C.A.

CARL M. KALTWASSER, made general manager of Stinson Division of Vultee Aircraft, has been closely identified with Vultee production, and will direct operations at the Wayne, Mich., plant.

Turning out Airacobras for the Army is **LAWRENCE D. BELL'S** job as president of Bell Aircraft, but he is also a newly elected director of Sterling Engine Co., builders of the new Admiral marine engine.

International News Photo

To help speed plane production, Lockheed has placed **DR. V. M. KRIVOBOK**, metallurgist, at the head of its new Structures Research Laboratory. Dr. Krivobok comes from Carnegie Institute.

Fernand de Gueldre

At Bendix Aviation Corp. **VINCENT BENDIX** (above) was re-elected president, and Charles Marcus vice president in charge of aviation operations. Board of directors was reelected in its entirety.

George R. Rinaa, Inc.

At the Caldwell plant of Curtiss Propeller Division, **R. ELMER MINTON** (above) succeeds George C. Rodgers as sales manager. Mr. Minton, formerly installations manager, joined Curtiss-Wright in 1929.

Dick Whittington

As partner of Butre & Co., **RANDOLPH C. WALKER** was active in the development of Lockheed, Vega, Menasco, and Aircraft Accessories Corp., and is now president & board chairman of the latter.

Underwood & Underwood

SAMUEL S. BRADLEY (above), **FRANK H. RUSSELL**, and **JOHN A. SANBORN** were respectively re-elected board chairman, president, and general manager of Manufacturers Aircraft Association.

Pan American Airways announces that **J. CARROLL CONE**, former Atlantic Division manager, has been appointed assistant vice president, and assigned to duty in the system's New York office.

His regular job is that of pilot for Eastern Air Lines, but **ANDREW McDONOUGH** was unaware that he had flown 620 m.p.h. while diving 21,000 ft. when he recently tested the Airacobra for the Air Corps.

Bachrach

Newly appointed comptroller of Brewster Aeronautical Corp. is **C. S. GOODWIN**, formerly with S. D. Leidesdorf & Co. During the World War he was chief accountant on several government projects.

Chrysler Corporation's Warren Ave. plant, which will be used for the manufacture of airplane parts, will have as operating manager **D. A. SAMSON**, former operating manager of the Dodge Main factory.

Addition to the sales staff of Lear Avia is **TOM STANGSYE**, for 11 years superintendent of aircraft radio and maintenance for United Air Lines. He will specialize on sales of airline equipment.

United Air Lines

To better coordinate its operating activities, United Air Lines has decentralized its eastern and western sales offices, appointing **RUSSEL F. AHRENS** (l.) and **HOMER J. MERCHANT** eastern and western sales managers respectively. Ahrens covers Denver east to the Atlantic seaboard, with headquarters in Chicago; Merchant has all territory west of Denver and will be located in San Francisco.

Houghton Wins Losey Award

The newly established Robert M Losey Award, in honor of Capt Robert M Losey (killed during an air raid in Norway, while attached to the U. S. Legation as a military observer), was presented to Henry G Houghton, Jr (above), Assistant Professor of Meteorology at M. I T In 1938 Houghton, assisted by W H Redford, developed a method for clearing fog over a limited local area by use of a calcium chloride spray, and has recently extended his research into the exact nature of atmospheric condensation processes in general Presentation on behalf of the Institute of the Aeronautical Sciences was made on Honor Night by Comdr F. W. Reichelderfer, Chief of the Weather Bureau

Funds for Research

A budgeted fund of $4,567,800 for NACA had been approved by the House Appropriations Committee of Congress as this was written and was headed for quick passage with the Independent Offices bill. This sum, for fiscal 1942, is $1,702,890 more than the 1941 appropriation, nearly half of which is to provide for additional personnel The new personnel are mostly with the new laboratory at Moffett Field, Sunnyside, Calif The Cleveland laboratory will not be in operation for a year or more NACA research is regarded as one of the most vital functions of the Government, with so much money being spent on aircraft, and with air war being largely a contest in design for performance

"Vinylite" Plastic Cockpit Enclosure

The newest "Ercoupe" all-metal, two-place monoplane features "Vinylite" plastic for windshields, cockpit enclosures and rear windows. Made from raw material supplied by Carbide and Chemicals Corporation, the plastic sheets are only 0.065 inches thick, yet are said to be strong and rigid enough to withstand the pressure of a 100 miles per hour air stream. In addition to affording advantages of non-inflammability and low maintenance cost, "Vinylite" plastic is said to be permanent in size and color and able to withstand all types of weather conditions (See photo, left.)

Ultra-High Frequency

Looking forward to static-free beam radio, the CA Administrator is installing 10 experimental transmitters along the New York-Chicago route. Eight will be in operation by mid-spring, and then will be service-tested Equipment has already been tested at Indianapolis, Pittsburgh, Los Angeles The three lines operating on the route will install receiving equipment in their planes When perfected, uhf will be extended to the airways system as funds become available

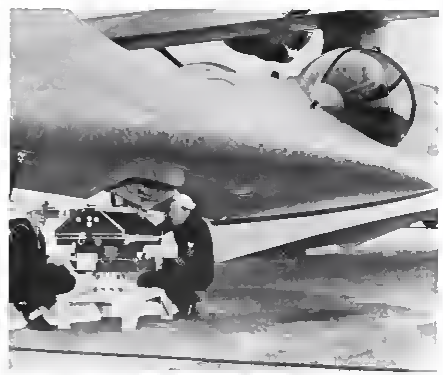
United Radio Projects

United Air Lines communications laboratory announces a 5000 watt radio transmitter, "the most powerful aeronautical ground transmitter in the world"; a new combination receiver and transmitter for planes and a huge antenna covering 600,000 sq ft. The receiver-transmitter for planes operates on 10 frequencies automatically selective The unit weighs 75 pounds as compared with 110 pounds for the present 2-frequency type In tests, pilots talked from Cheyenne with ground stations on Atlantic and Pacific coasts. Ground transmitters are being installed at key points on the system

An interesting exhibition of National Machine & Tool Progress will be sponsored by the American Society of Tool Engineers in Detroit Mar 25–29 New president of ASTE is A H d'Arcambal, consulting metallurgist of Pratt & Whitney Division of Niles-Bement-Pond.

Acme Staff Photographer from World

A NEW WRINKLE in engine heaters. At the Army's Camp Skeel in Michigan, an oil burning unit on the truck heats air which is blown through a flexible canvas tube to the engine.



Wide World

HUGE CAMERAS that will photograph 790 square miles from a height of 34,375 feet are being installed by Coast Guard in its new Consolidated PBY-5 long range bombers. This is a full-scale camera model used to prepare airplane fittings.

Transport Plane Priority Still a Problem

Airline Time for Air Corps Pilnts Propnsed

Washington (AVIATION Bureau) —Priorities for the airlines as against the Services involve pilots as well as airplanes Both will be a problem throughout the emergency.

The Priorities Board sent investigators to the West Coast to determine whether the manufacture of transport planes is actually interfering with production of military craft The basic question, of course, is one of degree how much value must the Army and the Board place on the airline system as an aid to defense?

The airlines desire the development of new models, particularly four-engined types, for post-war service This takes a great deal of engineers' time, an important factor just now

Actual production of airplanes for transport does not worry the Army too much as yet Total airline requirement is less than 1 percent of total production But Army insists it will resist any changes in specifications for replacements unless they are absolutely necessary, and will specify exact numbers and types of planes and engines to be released to the airlines

Training of military pilots in airline co-pilots' seats is being considered. The object is mutual exchange of military and airline experience The proposal was not official at this writing but CAA had ruled that such procedure would be legal The Army would get many pilots trained on instruments, and the total U S aviation manpower would be increased, because of the double-up

Airlines would get time on four motored equipment, would be partially relieved of the pilot shortage But the captains would be much engaged in instructing and less in flying their ships Already the coaching of co-pilots is reserved for summer, as much as possible, when flying duty is lighter And if the military training continued long enough, the supply of airline captains would dry up, since captains come from co-pilots' seats.

CAB Reports On Study of Salt Lake Aeeident

St. Louis is Fourth Sinee "Safety Period"

Washington (AVIATION BUREAU)—Reporting its investigation of United Air Lines' accident at Salt Lake City, Nov 4, 1940, in which 10 persons were killed, the Civil Aeronautics Board finds that the probable cause was malfunctioning of the Salt Lake radio range In addition, the board finds two "substantial contributing factors ...": (1) failure of communications operators, whose duty it is to monitor the range, to detect and make known its malfunctioning, and (2) failure of Capt Howard M. Fey, on Trip 16, to follow to the fullest extent the well-established let-down procedure

Further, as a result of this study, which took three months and involved the introduction of 137 exhibits and 78 witnesses, the board recommends That the Civil Aeronautics Administration study the effect of certain atmospheric conditions on the Salt Lake range and devise remedies; that an effort be made to develop visual range monitoring devices to replace the present aural ones, with possible automatic warning, re examine present training procedures of communications personnel and improve them, hasten the development of ultra high frequency for radio range for use especially in mountainous terrain; standardize the let-down procedure on each airport for all aircraft, both civil and military; study the advisability of certificating air navigation aids not owned by the Government, such as the localizer at Salt Lake

The board is studying the possible amendment of CAR with reference to communications failure, contact flight, landing, emergency procedure. It is also considering the promulgation of regulations on dispatch procedure and let-down-through

AN ALL CARGO daily schedule is now being operated between New York and Chicago by United Air Lines. This night photograph shows part of a 1700 pound cargo being loaded at LaGuardia Field.

PAA Flies "U Bend"

Coach British Pilots

To double the load of passengers and war-time mail from Europe homebound, Pan American Airways recently sent the Dixie Clipper on an 11,000-mi proving flight over the big U bend route from Portugal via West Africa, and the "hump" of South America to New York

This route is for westbound return trips, which in winter have to buck 50 m p h. westerly gales, too much of their load is fuel. Rough water at Horta also delayed departures westward

The Dixie Clipper, equipped with new engines, new propellers, new fuel tanks, made the usual 3,118-mi. hop from Bermuda to Lisbon direct, and was taken over by Chief Pilot Harold E Gray for the U trip west

Distances: Lisbon to Bolama, Portugese Guinea, 1,917 mi 3,100 mi to Port of Spain, Trinidad Trade winds, that used to blow the Spaniard's scrotes, will now boost the airboats The route is nearly twice as long as the North Atlantic run, but it will carry the load.

The U bend was authorized by President Roosevelt, who is the boss of foreign relations Establishment of regular service must be okayed by CAB.

CAD Announces Decisions

As Priority Information

Washington (AVIATION Bureau) —Unprecedented action was taken recently by the Civil Aeronautics Board in making public a series of decisions on applications for route certificates prior to publication of opinions This was done to give the Priorities Committee of the Defense Commission early information on airline equipment that will be needed. The Army is fighting for every man-hour it can irritate in aircraft plants on combat planes. All of the certificates granted were in the South This southern airline development is going on in the South because, for one reason, it is long overdue. Another, and perhaps more important reason is that of defense Flying facilities approaching all points of the Southern border are considered necessary precautions against any future attempts at invasion.

St. Louis Accident

Fate threw 1941's first airline accident into the lap of Transcontinental and Western Air, at St. Louis, on Jan 23, two persons were killed. During 1940 there were three line accidents: Lovettsville, Aug 31, 25 killed; Salt Lake, Nov 4, 10 killed; Chicago, Dec 4, 10 killed. The 17-month no-accident record started March 28, 1939, and ended with the Lovettsville crash.

Military Training

For Airline Pilots

Senator James Mead of New York introduced a bill in Congress which would provide a training center, under the Army Air Corps, where commercial airline pilots would be given one month's military training each year. This is only one of several plans being discussed in

TRANS-CANADA AIR LINES now overhauls and maintains propellers at its Winnipeg shops for the Royal Air Force. Instruments are also serviced for R.A.F. ships.

defense agencies to provide such training and conditions as would enable pilots to double on commercial and military service.

Amerlean's

"Millinn Milers"

In 1940 there were 34 American Airlines pilots who flew their millionth mile, bringing the total of American "Million Milers" to 127, said to be the largest such organization in the world. To each Million Miler the airline presents a gold watch

Oxygeo for Altitude

Suitable oxygen equipment and a supply of oxygen must be carried by transport planes flying more than 30 min at 10,000 ft or flying any length of time above 12,000 ft. This ruling, which is to take effect May 1, 1941, was promulgated by Civil Aeronautics Board Feb 6 It does not say that the equipment must be used; only that it must be available. No reference is made to passenger use

Transpnrt Doings

United Airlines is inaugurating a new overnight sleeper service between New York and Denver

Braniff Airways is building a new hangar in Oklahoma City, costing $21,200; will be completed in March

American Airlines will include an intermediate stop at Bridgeport, Conn., on its route number 18 between New York and Boston

Continental Air Lines is inaugurating on its route 43, Wichita-Denver, a stop at Hutchinson, Kan., which has been prevented by airport construction

All-American Aviation inaugurated daily cargo for Railway Express over a 205-mi. pickup route. This adds 14 western Pennsylvania towns to the system

TWA aviation writers trophy award this year will include photography The cash awards will total $775

Pennsylvania Central has developed a new steam heater for its planes; it will maintain a constant temperature of 72 deg

Delta Airlines gets a certificate for Cincinnati, Ohio, and Atlanta, Georgia, via Lexington, Ky., and Knoxville, Tenn

Dixie Airlines was denied a route between Pittsburgh, Atlanta and Birmingham

Trans-Canada says men are best nurses of children on their line. They substitute willingly while mother takes a nap

AIR TRANSPORT INDICATOR

February 1, 1941

96.7

Which is the ratio of passenger-miles reported by the Air Transport Association for all domestic lines for January, 1941 to the figure for January, 1940 Total for the indicator has fallen back considerably from last January's figure For the first month of 1941 traffic stood at 53 412 376 revenue passenger miles—only 96 34 per cent of January 1940

See Finance page for individual companies traffic figures

Eastern Air Lines opens ticket office in the Eastern Air Lines Building, Rockefeller Plaza, New York Birmingham included on New York-New Orleans; Brunswick, Ga., is a stop on route 6, New York and Miami.

Marking the largest aircraft merger since the Curtiss-Wright-Atlas Corp deal (subsequently dropped), Aviation Corp plans to absorb Aviation & Transportation Corp. Under the proposal the latter company will be dissolved by distribution to shareholders of a liquidating dividend consisting of its holdings in Aviation Corp and cash remaining after the transaction. Through the merger Aviation Corp will acquire control of New York Shipbuilding and Auburn Central Mfg Co. Aviation Corp. also plans to sell to shareholders 1,455,555 capital shares on the basis of one additional share for each three held. Besides its subsidiaries, Aviation Mfg Co and Republic Aircraft Products, Aviation Corp owns 62 percent control of Vultee, 34 percent of American Airlines and large stockholdings in Pan American Airways and Roosevelt Field.

Other new financing include the sale by Northeast Airlines of 128,892 shares of common stock and 50,000 shares of Brewster Aeronautical Corp in a private sale at $12 a share. Everel Propeller Corp. plans to sell 90,000 shares through underwriters, and United Aircraft Products is raising new capital through the issuance of 75,000 shares of preferred stock. Thompson Products has arranged for a $4,500,000 bank loan, repayable in ten annual installments, and will use the proceeds to refund short-term bank loans.

Reflecting the fact that aircraft sales last year were double those of 1939, the forthcoming 1940 annual reports of most leading producers are expected to show record profits. Among those with earnings at new high records are the Glenn L. Martin Co., Curtiss-Wright Corp., United Aircraft, Douglas and Brewster. Boeing is believed to have neared the break-even point last year, as against a $3,284,000 deficit in 1939. Both Boeing and Consolidated, in the four-engine plane field, are geared up to a large output in 1941 and their earning power probably will be more in line with the prominent position they occupy in the industry.

Shipments of Bendix Aviation are running 100 percent ahead of 1940. Estimating the overall job to be done by his company in supplying the Army, Navy and nations resisting aggression, President Vincent Bendix places contracts secured and in prospect at a total requirement of $310,000,000. Practically all of this business will call for delivery before the end of 1942.

National Aviation Corp., largest of the aviation investment trusts, was among the first to apprise stockholders of its 1940 operating results. Net assets, which consist largely of stock holdings in all branches of aviation, amounted to $10.67 a share at the 1940 year-end, as against $16.02 on June 30, 1940. Divi-

(*Turn to page* 106)

—By Raymond Hoadley—

First quarter sales and earnings of the aircraft manufacturers should run well in excess of a year ago in most instances, although volume in this period probably will be the least of any quarter in 1941. As the highly profitable foreign business is likely to represent a smaller percentage of total output than in 1940, profit margins may be somewhat lower. Higher taxes and increased labor costs also will be a factor tending to reduce the percentage of gross sales carried through to net income. Besides record high backlogs and sales there will be more extensive use of subcontracting this year. Although the aircraft industry is cited in defense quarters as one that has adapted subcontracting to its advantage, pressure is being exerted on the plane and engine makers to extend the farming out system much further. Meanwhile, it appears likely that air traffic gains will be less percentagewise than in 1940. A shortage of pilot personnel, even more than a lack of extra equipment, may place a ceiling on the airlines' ability to handle the record traffic demand that should develop a few months hence.

Current Earnings Report

Company	Period			Net Profits 1940	Net Profits 1939	Profits per share 1940	Profits per share 1939
Aviation & Transportation	12 mos.	Sept	30	d$529,389	d$371,415		
Bendix Aviation	12 mos.	Dec	31	9,310,074	4,485,972	$4.42	$2.14
Bell Aircraft	12 mos.	Dec	31	284,745	9,203	1.14	0.03
Northeast Airlines	3 mos.	Sept	30	9,562		0.33	
Piper Aircraft	12 mos.	Sept	30	157,823			
Vultee Aircraft	12 mos.	Nov	30	374,000		0.48	

d — deficit

With the Airlines

Company	Ravenue Passenger-Miles* December 1940	December 1939	% Gain	12 Months 1940	12 Months 1939	% Gain	Ravenue Passengers December 1940	December 1939	% Gain	12 Months 1940	12 Months 1939	% Gain
American	31,861	20,672	53	311,477	207,363	50	y74,481	53,030	40	x810,339	488,604	65
Braniff	2,662	2,003	32	36,029	19,815	82	9,064	6,234	45	115,410	62,247	88
Chg. Southern	1,070	922	16	16,079	9,242	74	2,554	2,237	14	41,875	23,353	79
Eastern	17,365	11,683	49	160,000	102,904	55	y31,000	21,304	42	x317,582	208,286	52
Inland	244	196	24	3,258	2,272	43	946	772	23	12,518	8,757	43
Mid Continent	599	396	28	6,426	4,194	53	1,951	1,638	26	23,672	16,634	43
National	563	283	98	4,819	2,143	124	2,309	1,301	79	20,919	9,935	110
Northwest	3,229	3,119	03	51,541	34,749	45	9,887	8,052	L14	130,400	88,003	48
Penn Central	2,362	1,835	28	37,579	21,193	77	12,202	10,550	13	210,436	122,303	72
TWA	x12,136	9,011	34	x145,475	90,160	61	y24,182	19,120	10	x297,026	181,076	64
United	11,122	12,151	L08	222,331	148,354	50	y32,120	y24,099	33	x418,223	262,135	59

* Omitted y — November L — Loss x — 11 months

Industry Backlog

Unfilled orders of the aircraft industry rapidly are approaching the four billion dollar mark and will mount considerably higher before summer as the proposed 1941 procurement programs of the United States and Great Britain take form in actual orders. A year ago the industry's backlog hovered around one billion dollars, an all-time high at that time. Four automobile companies are spending over $100,000,000 in new plants and equipment to produce aircraft engines for which they have orders aggregating $409,000,000. At the same time plans are going forward which will push the motor concerns further into the aircraft field through the fabrication of bomber parts and possibly fighter planes as well. Meanwhile, the aircraft accessory companies are building up formidable backlogs, those of the two largest units in this group, Bendix Aviation Corp and Sperry Corp., amounting to $200,000,000 and $100,000,000, respectively. Many new companies are entering the accessory business, some of them with large orders on their books before operations are begun. The following table gives the latest approximate unfilled orders of 25 primary producers with a backlog increase of $128,406,000 in the past month.

Allison	$235,000,000
Aviation Corp	20,000,000
Beech	20,000,000
Bell	62,000,000
Boeing	206,000,000
Brewster	107,000,000
Buick	36,500,000
Cessna	11,000,000
Consolidated	320,000,000
Continental	45,000,000
Curtiss-Wright	500,000,000
Douglas	340,000,000
Fairchild	20,000,000
Ford	122,300,000
Grumman	90,000,000
Lockheed	275,000,000
Martin	320,000,000
N. American	210,000,000
Northrop	27,000,000
Packard	217,000,000
Republic	60,000,000
Ryan	11,000,000
Studebaker	33,900,000
United Aircraft	425,000,000
Vultee	90,000,000
	$3,773,400,000

dends of 75c a share were paid as against 50c during 1939. President Frank Russell reported that on Jan 20 last, 24.5 percent of the company's funds were in cash and the balance in aircraft manufacturing and air transport stocks in the ratios of 51.8 percent and 23.7 percent, respectively.

Piper Aircraft may show sales of over $5,000,000 according to the estimates of W. T. Piper, president, who expects 1941 to show a large percentage of growth over 1940 in the private plane field. Last year the company produced approximately 3,100 planes and present output is at the rate of 4,500 units annually.

Pennsylvania - Central Airlines traffic showed an increase over the corresponding month of the preceeding year for the thirty-first consecutive month in January. PCA was the first line to report on 1941 traffic, announcing that January made a 21 percent gain in revenue passenger-miles flown and 17 percent in revenue passengers.

Here And There . . . *Bendix* reported a 70 percent sales increase in the 1940 calendar year. The company's fiscal year was recently changed to end Sept 30. . . *Piper Aircraft* had a $40,000 inventory write off last year for spruce that did not pass inspection and plans to use aluminum spars to do away with such losses . . *Curtiss-Wright* increased its sales deliveries approximately 170 percent in 1941 . . *United Aircraft's* taxes in the first nine months of 1940 were nearly nine times those of the preceding year . . . *Vultee's* $5,800,000 net sales in 1940 included $1,200,000 from the sale of manufacturing rights . . . Lawrence D. Bell, recently sold 1,000 shares of *Bell Aircraft*, retaining 31,510 shares . . . *Brewster's* 1940 sales were about ten times the $960,591 reported for 1939 . . . *Canadian Pacific Railway* is understood to have under negotiation the purchase of six Canadian airlines at a reported price of $12,000,000. . . *Buick* is negotiating contracts with the United States Government that will bring its backlog of aircraft engine orders up to $96,000,000 . . . *Pan American Airways* has a new pension system to cover its 6,000 employees in 50 countries and colonies . . *Breeze Corp.* has a backlog in excess of $10,000,000. January deliveries totaled over $500,000 . . . *Penn-Central* has become the country's fourth largest airline in number of cities served (32 in 12 states) . . . The Wright engine division of *Curtiss-Wright* had shipments of around $65,000,000 in 1940, against a backlog of approximately $375,000,000 . . *Brewster* received a substantial order from the Dutch East Indies recently . . . *National Aviation Corp.*, through a subsidiary, Washington Airport, Inc., has sold its property in Hybla Valley, Va., to the federal government for $80,000 . . . *Beech Aircraft Corp.* expects to reach its maximum rate of output by midsummer . . . *Bendix Aviation* declared a $1 dividend payable Mar 1 as compared with a 50c disbursement in March, 1940 . . . *Kinner Motors* paid a 5c. dividend Feb 15 and intends to establish this amount as a quarterly rate . . . *Bell Aircraft* has a $2,000,000 order to make recoil adapters for machine guns . . . There were no strikes on any of the airlines during the year ended June 30, 1940, according to the National Mediation Board.

What? No Trigonometry?

Educational requirements for Naval Reserve aviation students were relaxed somewhat recently when the Navy Department eliminated trigonometry and solid geometry as compulsory subjects in the total number of credits required.

Directory Corrections

In compiling the directory issue Air Associates Inc., (Bendix, N. J., Chicago, Ill., Dallas, Tex., Glendale Calif.) was omitted from certain classifications in the break down of accessory and parts manufacturers. In addition to being jobbers this organization manufactures armament and equipment, safety belts, controls, hydraulic controls and assemblies, de-icers, fasteners, filters, control fittings, generators, wind indicators, motors, parts and accessories, propeller parts, pulleys, aircraft and airport radios, screws, nuts and bolts, radio shielding and equipment, aircraft fuel systems, valves, wheels and brakes, and they should be listed under these headings as well as clothing and other supplies of which they are jobbers.

Since publication of AVIATION'S Directory Issue in February more detailed information has been received as to the [illegible] of Lear Avia Inc. and their listing should read as follows: Lear Avia Inc., Dayton, O. Pres. William P. Lear; V. Pres. T. S. Harris; [illegible] L. Moor; Treas. E. Henderson; Secy. M. A. Steele; Cont. L. E. Dickinson; Purch. Agt. J. G. Cardon; V. Pres. & Ch. Eng. R. L. Drake; V. Pres. & Ch. Mech. Eng. A. W. Ryberg; Sales Mgr. R. S. Van Cleve; Dir. Publ. Rel. H. W. Roberts (N. Y.). Lear Avia of California, Inc., 1030 N. McCadden Pl., Hollywood, Calif. (wholly owned subsidiary of Lear Avia Inc., Dayton, O.). Personnel (see Lear Avia Inc.) V. Pres. & Gen. Mgr. R. R. Stoddart; Mgr. Equip. Div. R. M. Mock; Mgr. Motor Div. V. A. Hesser. Branches: Atlantic Div., 30 Rockefeller Plaza, New York, N. Y., Dir. Mgr. S. M. Nechill; N. Y. Service, Roosevelt Field, Mineola, N. Y.; Govt. Dist. Office, 9th & Kearny Streets, Washington, D. C., Dist. Mgr. L. A. Schulling; Wichita Branch, Municipal Airport, Wichita, Kans., Branch Serv. Mgr. G. Handwerk; Export Representative L. Gellis, Fgn. Mgr. Lear Avia Inc., 30 Rockefeller Plaza, New York, N. Y.

Taylorcraft Dedicates New Plant

At a very successful two-day meeting, Taylorcraft combined its distributors' meeting with the dedication of its new plant at Alliance, Ohio on February 4th and 5th. President C. G. Taylor opened the meetings the first morning with a welcoming speech, and then Vice-president Dick Depew gave an address.

Carl Elkins introduced the distinguished visitors, and was followed with short talks by Paul Yates, Jim Masterson, Frank Sunderland, Charlie Miller, John Bowser, Harold White and A. C. Fisher. Continental Motors was host at luncheon, and Lycoming Motors was host at the evening dinner.

The second day was devoted to dedicating the new plant. Following distributors' meetings, at which Lycoming, Continental and Franklin motors representatives were on the program, a buffet luncheon was served at the plant. Dinner in the evening was at the Alliance Country Club.

Sportsmen's Show Big Success

Thousands of Easterners crowded into New York's Grand Central Palace during the week beginning Feb. 15th to see the light plane exhibition put on in connection with the National Sportsmen's Show. Greatest attention was centered on the dozen makes of airplanes and gliders that were shown.

Manufacturers reported they sold a number of planes and secured names of many prospects who should buy planes in the spring or summer. In addition to the light plane builders, many other organizations, including *Aviation*, had exhibits.

Weekend Flight

Nearly 100 persons, most of them pilots, attended a weekend flight of the Wisconsin Civil Air Corps at Beaver Dam, Wisconsin, January 25-26. In spite of poor flying conditions more than 20 planes made the trip, the rest of the pilots using train, bus or automobile to attend. Members of the corps attending came from Waupun, Racine, Kenosha, West Bend, Fond du Lac, and Milwaukee, in Wisconsin, and from Waukegan, Illinois.

The Beaver Dam chapter, headed by Courtney Starkweather, was host to the fliers and arranged a program which included a smoker on Saturday afternoon, a ball in the evening, and a public breakfast on Sunday morning. The corps completed plans at the meeting for a mass flight to Beaver Dam to aid the city in the celebration of its centennial next July 4-6.

C. G. TAYLOR, President of Taylorcraft, left, and R. H. Depew, Jr., vice-president and treasurer.

Dowtown Showroom

Washington Aircraft and Transport Corp. of Seattle recently opened a downtown city sales office. One Aeronca and one Stinson 105 will be kept on the floor at all times. Prospective students and Seattle pilots will be able to get information there on financing planes, insurance and flying clubs.

Piper Cubvention Held

The fifth annual Piper Distributors Cubvention was held at Lockhaven, Pa., recently, with over 200 distributors, dealers and representatives from all parts of the country attending. The program featured the announcement of far reaching advertising plans to acquaint the public with the advantages of flying. Announcement was also made of the 1940 members of the Piper High Hat Club, a distinction which is conferred only on distributors who had sold over 100 Cubs in the past year.

A highlight of the convention was the first public display of the 1941 line of Piper Aircraft. The new Piper Coupe and Cruiser models will be equipped with mechanical engine starters as standard items. Performance of the Coupe has been materially increased by installation of a Continental 75 hp. engine, and Piper exhaust mufflers, first introduced in the Coupe last year, are now furnished with all Cruisers and Trainers, except 40 hp., as standard equipment.

New Equipment at St. Louis Airport

Radio Sonde weather reporting will be resumed at Lambert-St. Louis Field this month with new equipment, which is being installed by the Weather Bureau. A light radio transmitter sent aloft to 12 miles attached to a small balloon, sends back radio reports of temperatures, pressures and the moisture content of the air through which it passes. These reports are recorded on a special machine, which sets forth the information on a graph. This type of weather reporting was successfully employed here for about nine months, until last July, when the equipment then employed was sent to Alaska.

New Field Launched

The Private Flyers of America, Inc., a group of earnest young men who want to fly well, have leased their own field in St. Charles County near St. Louis, Mo., and have launched an improvement program designed to get the place in shape for operation by spring.

Situated three miles north of St. Charles, the airport comprises 56 acres of level turf. Drainage tile is being laid and there will be graded runways, the longest 2500 feet. The acreage will be seeded by air, seed being scattered from a hopper in a plane. There will be a 50x60-foot hangar and a small repair base. The field will be named "St. Charles Airport." Leasing is for 10 years.

New Flying Club

A Southern Wisconsin chapter of the Ninety-Nines, International organization of women pilots, has been formed by thirteen Madison women fliers. The new club is headed by Mrs. Melba Beard, winner of many women's speed races, and a charter member of the Ninety-Nines. Other officers are Marcia Courtney, vice chairman, and Mary Ahlstrom, secretary-treasurer.

Breakfast flights sponsored by the newly formed Tri-State Flyers Club of Joplin, Mo., are increasing Sunday activity at the municipal airport. Flyers are making trips to Joplin from Kansas City, Tulsa, Okla., and Coffeyville, Kan.

The club also is sending out invitations to airports within a 300-mile radius of Joplin, urging pilots to communicate with a club committee upon arrival in the city. The committee plans to be host to the visiting pilots, entertaining them according to their wishes, and assisting them in making any business contacts they may require.

Ten of the club's 30 members will purchase a new plane soon, possibly a 65 horsepower Luscombe, for their own flying pleasure, as well as for instruction purposes. The club hopes by its activities to give to Joplin an interest in flying which they believe has been under national par. With the impetus given to all civilian flying by the government's sponsorship of CPTP, flying clubs will expand rapidly.

Hess Gritchof

MEMBERS OF THE ELITE High Hat Club of Piper salesmen. This happy scene was snapped at the recent Piper convention.

TRAINING

Navy Air School Proposed for Calif.

Rep Ed V Izac, of California, introduced a bill to establish a naval aeronautical academy in the San Diego area. He wants the academy to train up to 25 percent of the annual graduates of the academy at Annapolis.

College Cram Course

Security Administrator Paul McNutt announces that the Government will provide a special three-month ground course to speed up the pilot training for 25,000 college students. The Army requires two years of college, or ability to pass an examination based on an equivalent amount of education. The proposed course is in effect a "cram session" to enable students to pass the examination. Details had not been completed as this was written.

High Flyers Courses

Wright Field is running a series of short courses in which a total of about 120 Air Corps pilots, from various units throughout the country, are being trained in the use of the latest equipment for operating at altitudes above 25,000 ft.

The training is based on information from air attaches in all parts of the world on the latest wrinkles in air war, and on information from the British, and indirectly from Germany. Much valuable information has come out of the altitude test laboratory of Captain O. O. Benson and Dr J. W. Heim.

As you probably know, all altitude work of the Army thus far, makes use of supplemental respiration; the sealed-cabin principle, so far, involves difficulties which prevent its application on so broad a scale as air defense.

The oxygen system in a modern bomber is a plumber's pipe dream, feed lines and reservoirs are located for the convenience of the crew.

Electrically heated suits; a mask with a metal breather bag concealed within the clothing; throat microphones; re-breathing apparatus — all are being studied and improved.

Visual aviation is being taken into every high school in Vancouver, B. C., and will possibly spread across Canada in the immediate future. Leslie J. Martin, president of the two elementary flying training schools operating at the Vancouver Civic Airport and Boundary Bay, B. C., announces that the instruction will be given gratis by instructors of the flying schools and motion pictures used in the aviation schools and prepared by the British Government will be shown.

The idea behind the work is to aid in vocational guidance of high school students. Harold E. Shelley, assistant chief ground school instructor at the airport training school will be in charge of this work. Twelve films on various technical and semi-technical training will be used, one film being shown at each of the two presentations weekly.

Traffic to and from the Municipal Airport at Kansas City will be speeded up by the opening of the new airport underpass now ready for use.

One way traffic in each underpass will make for ease in reaching the airport parking lot in the least possible time.

Built just across the river from "Old Town," the earliest settled part of Kansas City, the airport has been hampered by the inconvenient approach through a single, narrow underpass on a sharp curve.

Bernard DeWeese, Jr., formerly Chicago sales manager of Stinson Aircraft, and lately operations manager of the Chicago School of Aeronautics, has been placed in charge of the Pine Bluff School of Aeronautics, Pine Bluff, Arkansas. The new school, sponsored by William R. Kent, Memphis lumberman and owner of Southern Air Service, will train pilots for advanced flying at Randolph Field.

Lincoln Airplane & Flying School's 21st birthday was celebrated recently when E. J. Sias, president of the institution, was given a banquet at the Chamber of Commerce, Lincoln, Neb.

As one of the pioneers in the aviation school business, Mr. Sias has been in the continuous service of the Lincoln School since it was founded in 1920. Originally a mechanics school, the institution subsequently received a government rating for advanced flying and approval as an airplane and engine mechanics school. In 1933 it was selected as a primary training base for Air Corps cadets and later as an Air Corps technical mechanics school.

Starting February 15th, classes in welding of aircraft parts were given in the Wulsin Building, 224 E. Ohio St., Indianapolis, Ind., by the Indiana Aircraft School of Welding, Inc. The venture is an answer to the urgent need for trained workers in the national defense program.

The president, Paul E. Tucker, was formerly Indiana representative for a Los Angeles aircraft welding school. He states that during November of last year, this school placed 316 Indiana men in aircraft industries after they had been trained by the school.

Chief instructor of the new school will be Beecher Shipwash, a former employee of the Lockheed aircraft factories. David Wise is vice-president, and J. F. Tucker, secretary-treasurer.

Films Teach Flying

A new system of pilot training which promises to bring about a radical reduction of ground school instruction time has just appeared. The training is by means of hundreds of photographs, drawings and diagrams which make difficult aeronautical subjects easy to understand.

These pictures are contained in a course of 24 slidefilms, just produced by a Detroit commercial picture company, the Jam Handy Organization, 2821 E. Grand Blvd. The course is based on the official ground school material of the Civilian Pilot Training Program and checked and approved by the Civilian Pilot Training Service of the Civil Aeronautics Administration.

A slidefilm is made up a series of still pictures arranged in order on strips of standard motion picture film for projection on a screen. The pictures are accompanied by explanatory comments in type.

The Pilot Training Course contains the bulk of the necessary information in the field of civil air regulations, navigation and meteorology, upon which the private pilot is tested. Other subjects included in the course which are essential to a private pilot's education but on which he is not usually examined, are aircraft engines, aerodynamics, instruments and parachutes.

The films are designed to be supplemented by instructor and text book. The instructor can handle up to 200 students with the help of the pictures, although, naturally, the job can be done more effectively with small classes, all of whose members are capable of learning at the same rate of speed. Surprising results have, however, been obtained even with large classes. In classroom instruction the teacher reads aloud from the films and pauses at will, to emphasize any necessary points of special interest.

Nearly 2,000 photographs, drawings and diagrams are used in this course to explain different aeronautical problems. The films give, for example, a pilot's-eye view of aerial traffic, illustrate how lift is created, set forth the new radio procedure at control airports, explain magnetic variation, and show the inner workings of flight instruments. Each subject is carefully developed so that it is made clear to the average mind. In unofficial tests, students who were shown the pictures received from 10 to 15 percent better grades than those who had used other sources.

Similar visual methods of instruction have long been employed with great success by American industry in training personnel. More recently educational slidefilms were adopted by the German army for the instruction of its mechanized forces and by the Russian army for teaching parachutists. The United States Army is beginning to use the device for training mechanics, but not as yet on anything like the wholesale fashion of the German.

Clyde Sunderland

BOEING SCHOOL has added all these buildings for shop and dormitory use for its quota of Army Air Corps mechanics. By next month 300 men will be in this section of the school.

distances still count

It is a far cry from the creaking, lumbering conestoga wagon to the sleek smooth-riding aircraft of today In terms of time, distances have shrunk almost, but not quite, to the point of becoming inconsequential Despite the speed with which ground can be coveted, *distances still count* in the production of aircraft as they do in the manufacture of every commodity

Distances count in terms of proximity of raw materials, of tools, of accessories, and of parts *Distances count* when you consider accessibility of the markets of the Nation *Distances count* in the important consideration of a location less vulnerable to interrupted production by unforeseen events of the future

Authorities agree that in these factors *distances still count*, and where distances count, the State of Illinois occupies a favored position in industry

INVESTIGATE THE ADVANTAGES OF AN ILLINOIS LOCATION Check ALL the advantages Illinois offers to manufacturers of Aircraft and Aircraft Parts, Accessories and Tools. Write the Illinois Development Council, at Springfield, for a special report containing detailed facts on production factors which are especially advantageous in Illinois—a report containing data on raw materials, labor, power, fuel, equipment, taxes, transportation, markets, and available plant sites.

Please list any special or unusual requirements in production or distribution, in order that a truly practical and informative report may be submitted for your consideration Your inquiry will, of course, be kept strictly confidential Write—

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THE STATE OF BALANCED ADVANTAGES

Courtesy United Air Lines

"GO AHEAD '41"

ALLOY NICKEL STEEL

Go ahead, '41! Speed up your schedules. Push up your horsepower. For those improved 1941 engines there'll be time-proved Nickel alloy steels to carry safely heavier loadings and withstand higher stresses.

During 1940—as in years past—the wear resisting, fatigue defying abilities of Nickel alloy steels were convincingly demonstrated by service in practically every aircraft engine built in America or abroad. Go ahead, '41. *More power to you with dependable Nickel alloyed steels.*

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Nickel alloy steels provide the improved strength and toughness required for aviation applications Notable advance has been made in using 18% chromium—8% Nickel type stainless steels in the construction of wing, tail and fuselage assemblies. Properly processed, these alloys combine excellent corrosion and fire resistance with high mechanical properties. Your inquiries regarding applications of Nickel alloyed metals are invited

Recent Books

SQUADRONS UP! *by Noel Monks*, 260 pages, $2.50. Published by Whittlesey House, New York.

This is a story of the RAF thus far in the war. It is one of the most exciting books to be published since the war began. The author, a correspondent for the London *Daily Mail*, was in France with British fighter squadrons until the fall of France. For outsiders it is a better book than if it were written by one of the pilots actually engaged in the affair, because the author could tell what he saw without being restrained by modesty. Pilots don't talk—at least until it's over.

This is particularly a story of two famous fighter squadrons—a day by-day account of their pilots and how they lived and fought. It is a factual account of what RAF pilots in Hurricanes did to Nazi pilots in the best planes Germany could build. The book is reassuring because it shows what we have all hoped—that even with numerical superiority, Germany cannot wipe out the fighting heart of the British.

While written for the popular audience, there is much in this book to delight the experienced aviation man. There is much talk of both airplanes and pilots. Undoubtedly the book will have as wide a sale in this country as it already has in England.

AIRPLANE MAINTENANCE, *by Hubert G. Lesley*. 511 pages, $2.75. Published by John Wiley, New York.

Mr. Lesley is maintenance engineer of Eastern Air Lines. He knows his business and he has written a good book. It will be of special value to airline mechanics who want to get ahead, and to students who hope to get maintenance jobs at airports.

Chapter headings are as follows: maintenance, materials and processes, controls, hydraulics, electrical circuits, structural repairs, aircraft welding, de-icing equipment, instruments, fuel and oil system, heating systems, vibration. The chapter on materials and processes runs to 136 pages and is especially good. The section on hydraulics, that on de-icing and some of the others contain material found in no other book.

YOUR FUTURE IS IN THE AIR, *by P. P. Wilhs*. 171 pages, $2. Published by Prentice-Hall, New York.

The author is an advertising man with the agency that handles the American Airlines account. The book is an interesting story of what that airline has done to sell the public on air travel. It reviews air transport history, and gives a blow-by-blow account of what the airlines had to do to overcome sales resistance.

The book is filled with charts, graphs and advertisements which make it easy reading. It will interest all airline people, all advertising men who have or want aviation accounts, and all college students trying to get into the fascinating advertising business.

We have only one criticism. Being written from the advertising agency viewpoint, the book doesn't tell what a swell job Ed Bern and his public relations boys have done. We suggest that for Vol. II.

BUILDING AND FLYING MODEL AIRPLANES. 246 pages, $2. Published for Air Youth of America by D. Appleton-Century Co., New York.

Model airplane enthusiasts will not be the only ones interested in this book. Anyone who likes planes is going to get both pleasure and instruction from its contents. Prepared by experts who have had years of experience in building and flying model airplanes, it is up to date on all recent developments. As such it is one of the most accurate and authoritative books on the subject published.

The book contains detailed descriptions of every step in both the building and flying of model planes and is profusely illustrated with drawings, diagrams and photographs. For those actively interested, a valuable feature will be the inclusion of plans for the construction of five model planes developed by Air Youth of America. A glossary of terms and an index add to the book's usefulness.

AERONAUTICS IN THE UNION AND CONFEDERATE ARMIES, *by F. Stansbury Haydon*. John Hopkins Press, Baltimore, Md. Vol. I, xxii, 419 pp., 45 plates, $4.00.

Long- but - undeservedly - forgotten names emerge from the pages of Mr. Haydon's book. To compile this remembrance of aeronautical things past, Mr. Haydon has consulted every available source carefully sorted all pertinent data, and presents his findings in a painstaking yet interesting account of the efforts of the pioneers in aerial warfare. His history starts with military aeronautics prior to 1861 and carries through the Civil War to March 1862. Volume II will continue through the War and include much reference material. The four years of preparation and research for this work is reflected in its exhaustiveness and its liberal footnotes and complete index.

HORIZONS UNLIMITED, a Graphic History of Aviation, by *S. Paul Johnston*. 354 pages. $3.75. Published by Duell, Sloan & Pearce, New York City.

This is the most interesting history of aviation yet published. The book is a handsome one, with scores of large photographs. It begins with a chapter called "Oceans of Air," continues with a chapter on how air craft fly, and then moves into a history of lighter than air machines. Then five types of heavier than air craft are discussed, with most space given to airplanes.

The history of the airplane is unusually complete and well written. Each section discussed is illustrated with a wealth of fine photographs. The author, a former editor of AVIATION, is now Coordinator of Research for NACA, and is a Lieut. Commander in the Naval Reserve.

Window Shopping

Carboloy Engineering Bulletin GT-123—Contains 16 pp. of up-to-the-minute data on machining steel, cast iron, and non-ferrous metals and non-metallic materials. Carboloy Co., Inc., Detroit, Mich.

Exrite Tool Tips—November issue of this 8-p booklet, the number is devoted entirely to aircraft machine and aircraft machining operations. Ex-Cell-O Corp., 1238 Oakman Blvd., Detroit, Mich.

The Houghton Line—November-December, 1940—A highly personalized house organ which contains mostly philosophy with some highly interesting information on lubricants and metal treating oils and processes. E. F. Houghton & Co., 3rd and Somerset Sts., Philadelphia, Pa.

Roebling Rubber Covered Wires & Cables—A complete catalog of illustrated wire in 36 pages with numerous illustrations. John A. Roebling's Sons Co., Trenton, N. J.

Thor Airplane Tools—Electric & Pneumatic—An 18-p. catalog illustrating Thor drills, screwdrivers, rivet setters, grinders, riveting hammers and allied equipment. Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Ill.

1861 Magal Gen Circular—All those actively engaged in the maintenance, salvaging and manufacture of equipment needing protective coatings should send for this bulletin as well as a copy of the "Metallizer," latest organ of Metallizing Co. of America, Inc., 562 W. Washington Blvd., Chicago, Ill.

Speed Nut applications—A 16-page illustrated catalog. Tinnerman Products, Inc., 2074 Fulton Rd., Cleveland, Ohio.

Wrought Washer Stock List—No. 55 D—Listing washers, expansion plugs, stampings, locks and dies for the aircraft industry. Wrought Washer Mfg. Co., Milwaukee, Wis.

Kutmore High Speed Adjustable Hollow Mills—A 10 page loose-leaf bound folder—Catalog No. 14—describing a full of special adjustable hollow mill cutters. Kutmore Mfg. Co., 841 Lake Ave., Rochester, N. Y.

Equipment Review—October, 1940—A regular publication devoted to steel alloys. This issue deals entirely with aircraft applications. Electro Metallurgical Co., 30 E. 42nd St., New York, N. Y.

Firerock Hand Book—A complete (74 pages, 150 illustrations) handbook of factory floor, stairs, roof maintenance. Firerock Co., 23rd and Wyoming Sts., Philadelphia, Pa.

Fostoria Localites—Circling ML 25—A 34 page catalog of lighting for seeing on the job. The Fostoria Pressed Steel Corp., Fostoria, Ohio.

Electronic Devices for Industry—A 20 page booklet summarizing industrial applications of photo-electric tubes. General Electric Co., Schenectady, N. Y.

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Production Battle

(Continued from page 73)

activity balk at the "invitation" to accept aircraft and armament sub-contracts The loss risks involved, lack of knowledge of the work required, and the possible permanent loss of peacetime markets are among the reasons advanced by these smaller manufacturers This is but another manifestation of the fact that government contracts—once eagerly sought—are now carefully eschewed The power to seize and operate private plants under government edict, however, will most likely elicit the necessary response from all concerned

Based on all these factors, little doubt remains that military aircraft production for 1941 will again show a sharp increase The extent of this output, however is highly problematical Informed opinion indicates that the air-frame producers will have the facilities to turn out planes at the rate of 50,000 a year by late 1941 or early 1942 Failure to produce engines and other accessories in sufficient quantities, however, may retard the plane manufacturing schedules

Smooth production lines are also dependent upon the continued flow of additional labor to man the expanded plant facilities While the industry has thus far obtained the men it needs without too much difficulty, this problem will most likely become increasingly more serious in the future All types of figures as to growth of the industry have been quoted The most vivid figures are probably found in the obscure statistics as released by the Department of Labor Using index numbers, and the adjusted three year average 1923-25 as 100, it is found that the aircraft industry, as expected had the largest gain from one year to the next.

Here are the figures employment in December 1939 was at 2100 0, in December 1940—4849 7—a gain of 131 per cent Payrolls on the other hand rose from an index of 2046 5 in December 1939 to 5381.2 a year later, or an increase of 163 per cent This comparison also shows payroll payments as rising at a higher rate and out of proportion to the number of added employees

While a few strikes in aircraft manufacturing plants have occurred, it is considered likely that orderly labor relations for the most part will henceforth prevail The NDAC has adopted measures to facilitate amicable settlements should future differences develop Moreover, public opinion as a potent force will do much to prevent stoppage of work Congress will also observe developments closely and stands ready to enact legislation to outlaw labor disturbances In any event the industry can look forward to higher labor costs as the economics of demand and supply continues to assert itself

Taxes, particularly excess profits taxes, have taken a heavy toll of aircraft earnings New tax legislation appears assured However, it will probably not be until the latter part of March that the shape and form of the new tax bill will become distinguishable In spite of the attention generally given the subject of taxation, it may be a safe assertion that this will not be the most important problem facing the aircraft industry The ability to produce airplanes—and to produce in volume without interruptions—will be the decisive factor in determining profits for the aircraft builders

Annual reports for 1940 of the aircraft manufacturers are currently being released to stockholders A preliminary examination of the early statements shows record earnings in virtually every case This is largely a reflection of the substantially larger shipments of last year It will not be long before earnings estimates of the 1941 first quarter will be available Shipments for this period, according to reliable reports will be truly astounding for a number of the leading aircraft builders Newly expanded facilities have recently been placed in service and have begun to accelerate the tempo of deliveries

Aircraft equities at the present time discount many of the adverse features of the industry and sell at a low ratio to earnings It must be recognized that stocks of other industrial enterprises are also in the same category in view of the many uncertainties of the future. As these doubts are dissipated, however, it is likely that on an earnings basis, aircraft equities may be in the forefront of any broad market upswing

As our own economy is similar in many respects to that of the British, it may be of more than academic interest to observe the pattern of events following that country's rearmament program and its effect upon the English aircraft builders

A gradual increase in taxation was resorted to until an excess profits tax of 100 per cent was attained Yet, in spite of this high tax rate British aircraft companies have had little difficulty in increasing their profits For example —Parnall Aircraft, Ltd, after full provisions for all taxes, was able to report a net profit of £177,786 for its 1940 fiscal year, representing a 39 per cent gain over the 1939 period and almost a 100 per cent increase over 1938 results A 10 per cent dividend on capital for 1940 was also declared. The growth in operations for this company is also interesting Combined work-in-progress and stock aggregated £52,568 in 1936 and expanded to £1,139,904 in 1940. Such mushroom development is not unlike the expansion history of U S aircraft builders

The Parnall chairman also reported that the company had a claim against the Air Ministry for inventions assigned but had acceded to an official request to postpone arbitration proceedings "in view of the grave national emergency." A policy of duplicating and in some cases triplicating tools was followed, "so that the enemy would have a very difficult task in interfering with our production"

Significantly, a recent issue of the London Economist stated "although it may be open to doubt whether excess profits tax will continue at 100 per cent, in view of its anomalies and inequities, and the obvious drag on our war effort which it involves any reduction is likely to involve compulsory investment in War Loans, and not increased dividends"

It can thus be seen that even high tax rates are no barriers to profitable operations Moreover, it is also possible that the Economist's comment as to dividend payments may find its counterpart in this country's financing of the defense program

British holdings of American securities and their constant pressure on the market has been attributed as one factor in retarding the upward trend of stocks While the basis of this contention may be a tenuous one, it may be of interest to note that a recent announcement indicated that British liquidation had been completed in such aviation equities as Aviation & Transportation Corp, Douglas Aircraft Co, North American Aviation Co, United Air Lines Transport Corp and United Aircraft Corp Still to be completed is the sale of a block of Curtiss-Wright Corp stock No other aviation securities appear to be involved at present Representing a newer industry, aviation equities have not had the opportunity to receive the broad European distribution that has been peculiar to investments in the more established American industrial enterprises This, however, may come after the war

BARRON'S STOCK AVERAGES

		Aircraft	Air Transport	60 Stocks
February 7	1941	38 22	22 31	73
January 31	1941	36 06	21 94	72
January 24	1941	38 25	23.34	73
January 17,	1941	25 48	24 56	74
January 10	1941	38 32	26 38	77
January 3	1941	38 59	26 62	78
February 5	1940	48 65	24 47	67

NEW KIND OF LIGHT

to speed production of fighter planes

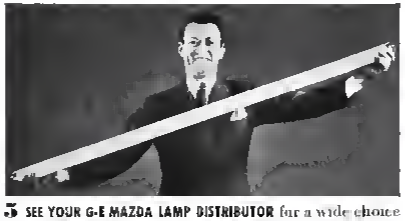
Packard orders 11 miles of new giant-size G-E MAZDA F (Fluorescent) lamps to light new engine plant

1 THIS 1918 FIGHTER helped win World War I. Built by Packard and powered by the famous Packard-built Liberty motor, it helps explain why Packard got order for new Rolls-Royce engines for Hurricane and Spitfire type planes. The ultra-close tolerances of these new engines help explain why Packard is using G-E Fluorescent lighting in its big new engine plant at Detroit.

2 TO KEEP A SPITFIRE'S WEIGHT DOWN to an absolute minimum, engine parts must be finished to flawless accuracy. Under ordinary lighting, inspections alone would create a thousand bottlenecks because *speed of seeing*—the time it takes your eye to absorb details—is directly dependent on the amount of light you have to see by.

3 PACKARD CHOSE G-E FLUORESCENT LIGHTING because in quality and diffusion it approaches actual daylight conditions—and because its greater coolness and efficiency permit new high levels of illumination. Packard plant (above) ordered 5820 fixtures each using two 5-foot 100-watt G-E MAZDA F lamps 13 feet above floor.

4 LABORATORY TESTS SHOW that the light output of G-E MAZDA F lamps has been increased as much as 40% since their introduction in 1938 . . . while prices came down as much as 45%. Like other G-E MAZDA lamps, they're made to give maximum light throughout life . . . *made to stay brighter longer!*



5 SEE YOUR G-E MAZDA LAMP DISTRIBUTOR for a wide choice of Certified Fixtures, complete with G-E MAZDA F lamps, ready to use (new 5-foot G-E MAZDA F lamp shown above). General Electric makes no fixtures, recommends Certified Fleur-O-Lier or RLM fixtures. For full information write General Electric Co., Dept. 166-AV-C, Nela Park, Cleveland, Ohio.

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Eliminating Failure

(Continued from page 41)

their electrical resistance in direct proportion to the stress imposed upon them The resistor, or strain gage, used in the new method consists of a "carbon-pile" strip approximately 2 in long, 1 in wide, and ⅛ in thick This is cemented longitudinally to the propeller blade but insulated from it electrically, and to its ends are attached two fine wires connected through electrical collector rings with a source of direct electrical current As the propeller blade tends to stretch or bend under stress, the resistor thus distorts with it, and the change in stress can be measured directly by recording the change in current flowing through the system See Fig 1

In actual practice the changes in voltage are very small, and must be amplified to be read accurately This is accomplished by sensitive amplifiers which are then connected to an "oscillograph" consisting essentially of an armature, or coil, between the poles of a magnet. The oscillograph tends to operate as an electric motor, and the armature tries to rotate first in one direction and then in the other as the reversals in stress cause reversals in the electric current A tiny mirror is attached to the circumference of the armature, with a fixed beam of light playing upon it As the armature oscillates, the mirror picks up the beam of light and flashes it up and down against a screen Now all that is necessary is to pass a strip of light-sensitive paper across the screen at any desired speed, and the beam of light will trace a wavy line on the paper, with the height of the waves directly proportional to the stress in the propeller A permanent record is thus obtained (see Fig 2), which can be studied and measured at leisure

Although none of the associated apparatus was essentially new the problems imposed by wide scale field measurements of the very small resistance variations of the pickups (⅟₁₀₀ of 1 percent) required the refinement of this apparatus to a point unheard of before. This has been done so that it is now possible to take simultaneous records of the stress condition at twelve points on the propeller on the test stand or under almost any flight condition of the airplane Fig 3 shows the apparatus in actual use in a test house during the course of an engine propeller test

The solution of the instrument problem was by no means the end, for with each new investigation there appeared new and unknown problems, each of

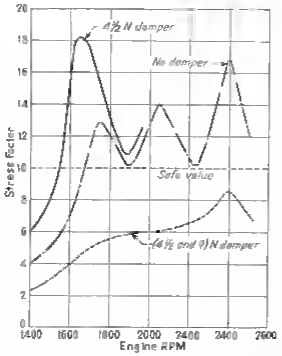

Fig 4 Effect of different damper orders upon propeller stress.

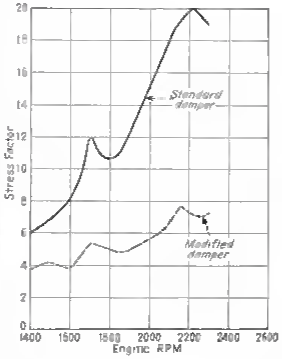

Fig 5. Effect of damper tuning on propeller stress

which was of fundamental importance Moreover, having measured these vibrational stresses it was necessary to provide a correct interpretation of their importance and the probable safety of the installation. This latter problem is in a constant state of revision as new evidence presents itself Each different modification of the propeller construction requires revaluation of its vibration strength and for basically different types of construction a completely different analysis is necessary

As the problem became more thoroughly understood it became apparent that the only sound means of evaluating the stress limit of safety lay in the analysis of accrued service background

In this study over 500,000 separate measurements have been made, a total of 45 persons are engaged in full time study of the problem and three of the outstanding experts in the country are retained for consultation on the fundamental principles involved

Specific Results

After the introduction of the controllable propeller in 1933 it was found necessary to make the specific propeller weight approximately 5 lb per horsepower in order to eliminate blade shank failures The only apparent means of ensuring a similar condition was to make larger propellers geometrically similar. On the basis of the original controllable propellers this would mean that propellers for present day 2,000 hp engines would weigh .83 lb per horsepower Clearly, then, a more rational design procedure was essential if the propeller were not to become the limiting factor in the size of the power plant.

By the industrious application of this stress measuring technique, specific propeller weights of 25 lb per horsepower are now possible in the immediate future and it is not believed that the possibilities in this direction are completely exhausted

Although by no means all, the following examples of problems attacked by the method will serve as indications of its utility

During the years 1933 to 1938, seven tip failures of a two way propeller on a 450 hp nine-cylinder engine were experienced During the initial stages of the investigation of this condition, a modernization program on the engine was being undertaken As part of this program, 4½ order (firing frequency) dampers were installed in the engine. A routine check (see results in Fig 4) on this engine disclosed an alarming condition of propeller stress as compared to the original engines with no dampers. And from the frequency of the propeller tip stress waves it was learned that most of the stress increase which resulted from the installation of the damper was at twice firing (and damper) frequency A mathematical analysis of damper behavior disclosed that under certain conditions the damper itself might introduce an excitation at twice its tuning frequency

The construction of this type of damper was such that a second roller at twice firing frequency could be used and the result of this change resulted in the eminently satisfactory stress condition shown in the lowest curve and labeled "4½ and 9N damper" When dampers of this kind were put into engines in service, the propeller failures ceased immediately

Reference to Fig 5 shows the result of an investigation of the effect of dam-

(Turn to page 120)

Eliminating Failure

(Continued from page 41)

per tuning upon propeller stresses In this case a new series of a well-known engine type was put into service on domestic airlines At the end of 1,500 hr of use on these engines, three propeller hubs were found to have dangerous cracks in them. When a stress survey was made, a condition labeled "Standard Damper" was found A more refined mathematical analysis of the tuning requirements for this type of damper construction indicated the need for a slight modification of the damper tuning This change resulted in the substantial reduction shown in the lower curve Subsequently, hundreds of propellers have been used more than 6,000 hr each on the engine with the indicated modifications and no further trouble was encountered

In a third case, an epidemic of tip failures on a three-way propeller and a nine-cylinder engine in transport service was found. A peculiarity of this problem was that only a small part (outer 3 to 4 in.) of the blade was broken This condition never resulted in severe damage to the airplane but was none the less potentially extremely hazardous

The initial investigation on the test stand with a test engine disclosed that a very sharply tuned stress peak occurred in the cruising region of the engine. The frequency of propeller stress was finally associated with the frequency of tooth mesh in the reduction gear itself However, the magnitude of the stress found was not believed sufficient to explain the failures experienced An inspired "hunch" that individual peculiarities of reduction gear assemblies might result in unusual conditions prompted an investigation of a gear which was in use when a propeller failure was experienced As shown in Fig. 6, this supposition was found to be correct Removal from service of a few reduction gears resulted in an abrupt end to propeller trouble

The problems discussed above were initially encountered before the stress-measuring technique was well developed As soon as possible, however, every effort was made to prevent vibration problems from ever occurring in service by making a routine check on each new combination of engine and propeller on the test stand and making a recheck when installed in the airplane

In the pursuance of this principle it was found that an engine-propeller combination which was service tested by thousands of hours of use on one type of airplane was unsafe at high engine

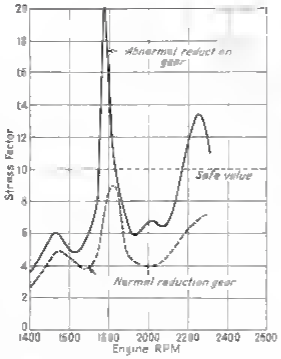

Fig. 5. Effect of reduction gear peculiarities upon propeller stress.

and airplane speeds on a new high-speed airplane This condition was brought about by the larger blade angles attendant upon high speed flight, the higher angle allowed a critical vibration which was normally above the maximum speed of the engine to come into the operating range

As part of a research program in engine dampers, a modification of normal crankshaft construction involving dynamic dampers on both front and rear counterweights had been developed When tried, this new crankshaft resulted in the very satisfactory condition shown in Fig. 7

In this way the new type of airplane just now entering airline service is given assurance of satisfactory and safe propeller performance

As is so often the case, the application of this new tool and technique was not confined to the original problem for which it was developed. Causes of fracture of engine crankshaft cases, and mounts have been investigated Impact stresses in landing gears and seaplane floats can now be studied Other industries such as truck manufacturers railroads, and even glass manufacturers are realizing the possibilities of the propeller stress pickup

Without doubt, however, the most important contribution of this development is the removal of propeller failure from the category of nightmare possibility to the realm of scientific prevention

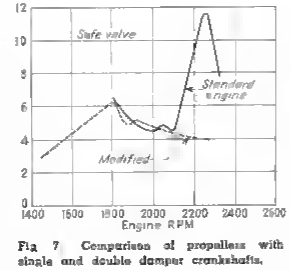

Fig. 7. Comparison of propellers with single and double damper crankshafts.

German Air Force

(Continued from page 31)

vantage in maneuverability—which is even more important than their rather less preponderating superiority in performance Another feature in which British machines of most types have had an initial advantage over those they have had to contend with is in firepower, both offensive and defensive The superiority in defensive armament, due mainly to their power-operated gun turrets of the British bomber types is most marked and has enabled them with astonishing frequency not only to escape from but to destroy enemy fighters attacking them. Without this adequate defensive armament the German bombers have been quite unable to put up similar performances against the British fighters who have consequently been in a position to attack with much greater confidence and determination. This superiority in armament has been equally great as between the fighters of the two countries when meeting each other

That this is not merely a belief or expression of opinion on our part is proved by the fact that in all operations during the period Aug 8–20, 701 German aeroplanes were known to have been destroyed while only 192 British machines were lost This has, of course, done something towards redressing the balance in numbers possessed by Germany when France surrendered; a balance which was, in every case, being rapidly reduced by the astonishing increase in output of aeroplanes from British factories. This increase is such that Mr Winston Churchill was able to state as far back as Aug. 21 that the production was already greater than that of Germany This statement was followed a week later by an announcement by the Minister of Aircraft Production (Lord Beaverbrook) that during the preceding week, more fighters and more bombers had been produced than ever before in the history of aviation

Automotive Methods

(Continued from page 47)

active production. In addition the experimental costs can be amortized over a larger number of units. With aircraft, all experimental projects are likewise considered as production possibilities but this cannot be regarded with the same degree of certainty. Therefore, designing the experimental model for production on as complete a scale as is the case with automobiles has not been found practicable. Of necessity, progress in this regard has been cautious. The Keller method of reproducing forgings, fittings, etc., represents a reasonable approach. Primarily, designing the experimental airplane for production is a specific problem which has many ramifications and it is suggested as an interesting subject for special analysis.

In conclusion, it must be said that the aircraft industry is unique in its development and resourcefulness under the handicap of small quantity production, which circumstance has stimulated ingenious methods and techniques adapted to its special requirements. The similarities between automobile and the aircraft industry are greater than the differences and the exchange of ideas is a logical development and conducive to progress if the art is not merely utilized but advanced.

The old method of inspecting parts

The modern method of inspecting bushings, bolts, etc. The output of the true reading dial instruments is from 5 to 10 times greater than with the calipers and micrometer. In addition, the inspector is much more certain of the results.

(Reprinted in part through the courtesy of the Society of Automotive Engineers)

REFERENCES

[1] & [2] *New York Times*. Standards Racked in War Materials. *New York Times*—October 26, 1940.

[3] Gilbert, H. N. Mobilization of the Aircraft Industry. More Plant Expansion No Answer. *Analyst*—August 1940.

[4] Miller, George. "Budgeting Expense and Cost of Handling Materials in Automotive Plants."

De-icing

(Continued from page 48)

the carburetor so that the liquid will flow by means of gravity to the carburetor. This tank should be equipped with a stick type quantity gage so that the amount of liquid can readily be determined. The tank should have a non vented filler cap, the vent being supplied by means of a ¼ in. tube from the top of the tank to some point underneath the ship. In case Anilol is used the tank should be made of stainless steel.

The outlet line from the tank should include a shut-off directly under the tank from which a ¼ in. aluminum tube can be run to a packed type panel mounted valve on the instrument panel. This should be placarded, 'Carburetor De-icer Valve." From the outlet of this valve a line can be run through the fire-wall to the air intake to the carburetor. This is easily accomplished by the use of a ½ in. pipe by ¼ in. rubber tube connection screwed into the side of the carburetor, as near to the air inlet as possible. A rubber hose should be used from the liquid tube outlet to the carburetor connection as required by the CAA.

The outlet into the carburetor should be plugged and drilled to give a flow of from 30 to 50 c.c. per minute. This flow should be measured with the ship in flying position by holding a glass graduate under the carburetor and collecting the flow for a 1-min. period.

The operation of this installation is quite simple. The tank of 1 gal. capacity is sufficient to operate continuously for 1 hr. and 15 min. in case of emergency.

The usual procedure, however, is to turn on the de-icer valve just long enough to remove the ice from the carburetor and then apply either more or less heat to try to change the conditions causing the ice. It is quite often the case that by removing the carburetor heat the ice particles will be presented at a temperature below which they lose their adhesive properties. Since the ice is readily removed, there is no danger in trying several conditions in order to find those under which the ice will not adhere to the carburetor. By using the de-icer valve only at such times as ice is actually formed, it is possible to conserve the de-icing fluid.

Crowell Trainair

(Continued from page 56)

cannot turn over, the student learns to adjust his belt immediately when he takes his seat. Then he learns to handle the stick lightly, to sit relaxed, and to use his toes, not his heels, on the rudder bar. The trainer will make continuous turns, and students can get the feeling of spins and how to recover. When the stick is pulled clear back, the attitude of the trainer is the same as that of a ship during landing and this familiarizes students with the correct angle for three-point landings. The trainer has a stabilizer, which is adjusted for different weights of students. The wheel behind the seat shifts the location of the seat over the 200-lb. semispherical base.

The Crowell Trainair was taken by its designer to Ann Arbor, Mich., last summer where it was used in conjunction with the University of Michigan C.P.T. program. A number of students were given primary instruction on the machine and were rated carefully on several phases of flight work. The results were distinctly encouraging.

The trainer costs less than $300 and should find an immediate sale wherever flying is taught, as well as high schools, private and public gymnasiums and elsewhere. It should be one of the answers for boys under sixteen who have the urge to fly but who are too young to get CAA approval for a student permit.

Its designer and distributors make no extravagant claims for it. In effect they say, "Here is an inexpensive means for orienting flight students and for teaching certain basic movements. In these days of mass training for both civil and military pilots, the trainer offers a means of additional instruction for students on the ground waiting their turn to fly."

The trainer is being built in a special shop at the Academy of Aeronautics at LaGuardia Field, New York City. Manufacturing and distribution rights are owned by the J.V.W. Corporation of Newark, who have handled the Link Trainer since its inception. The fact that this astute organization is back of the Crowell Trainair is a guarantee that it is dependable equipment.

Landplane vs Seaplane

(*Continued from page 39*)

Quite often the land plane enthusiasts state that the flying boat is, in general, a less efficient aircraft due to the bulky hull and limited possibility of having sufficiently highwing loading to obtain reasonable cruising speed, without suffering from undesirable water characteristics. Such statements are not correct when we come to large size airplanes considering the purpose of the machine. The undesirable water characteristics i.e. excessive spray, porpoising etc., do not represent inherent qualities of flying boats. By proper design of hull lines, coordination of wing and beam loading these undesirable qualities could be positively eliminated.

Wing Loading

The proper wing loading for commercial, long-range airliner represents a very important question for successful design. Whether the machine is a land plane or a flying boat, the primary consideration should be given to the efficiency at economical speed. It is well known that such economical speed usually represents a speed from 10–20 percent higher than the speed for best L/D of an airplane. (The reason for this is that the top of the "range curve" is practically flat in the vicinity of best L/D, because the ratio of propeller efficiency to specific fuel consumption usually is not the optimum for that speed and aerodynamic advantages of best L/D cannot overcome this factor.) It is correct that with heavier wing loading the "best L/D speed" of the plane occurs at higher velocity, but often the value of such L/D becomes lower and there is no gain obtained.

It is a well accepted law that when the size and weight of an airplane increase, the wing loading should be increased also. According to the observations and study of some reputable scientists, the "law of square and cube" is not strictly maintained in nature regarding the sea birds. Their wing loading increases with size not according to $W^{1/3}$ but by a somewhat lower exponent. Dynamic flight of some of these birds is extremely efficient and this is not only the aerodynamic cleanliness but harmonious correlation between wing and span loading. Apparently the lower the aspect ratio the lower the exponent of W becomes, when different species are compared. This is probably to insure steady and efficient flight characteristics in the vicinity of best L/D and towards the stalling. Such characteristics are exactly the qualities the long range transoceanic seaplane should possess.

Fig. 1 represents the plot of wing loading against the gross weight of the airplane based on Sikorsky amphibian and flying boat designs, and design studies. This plot corresponds to the assumption that wing loading varies in proportion to the weight in one quarter power. Generally speaking, for increasing the economical speed in a conventional design, without impairing the qualities of flying close to best L/D, it is necessary to increase the size of the airplane and corresponding wing loading.

It is reasonable, therefore, to assume that the general aerodynamic design of the wing group with respect to wing loading, aspect and taper ratio and even the location of the power plant, would become similar for both types of airplanes—flying boats or land planes.

Following the present design trend, the land plane probably would be a low or mid-wing monoplane, with main landing gear retracted in the wings and nose wheel in the body. The high wing monoplane will always be heavier due to excessive weight of the longer landing gear legs, though such a type has many attractive features such as perfect visibility for passengers, or what is really important, inherently better stability characteristics particularly at higher angles of attack, where most of the economical speeds occur.

The flying boat, on the other hand, must necessarily have a high wing arrangement in respect to the hull. To secure comparable stability at desired regime the low wing monoplane should have a somewhat larger horizontal tail or be moved farther aft than in high wing monoplane. This means additional drag, some weight, and may result in excessive stiffness at higher cruising speeds.

The size of the body in large machines will be dictated solely by the volume required to accommodate passengers and other items of useful load, therefore, the fuselage of the landplane concerning its cubic displacement should not have less volume than that of the flying boat hull.

In the sizes contemplated, the planing beam of the hull becomes smaller than the diameter of the body, because the beam increases only in cubic root of the weight and has no connection with the size of the body, which evidently grows larger in proportion. The finess ratio of the body could be decreased with growing dimensions, especially for the high wing flying boat monoplane where shorter horizontal tail could be used, due to its better inherent stability. For the size of 100 ton flying boat, a circular body with 1 6 finess ratio becomes quite feasible and such shape already represents a very efficient "volume to drag ratio."

All this leads again to the conclusion that the cross-section for both bodies, fuselage and hull, would be approximately the same.

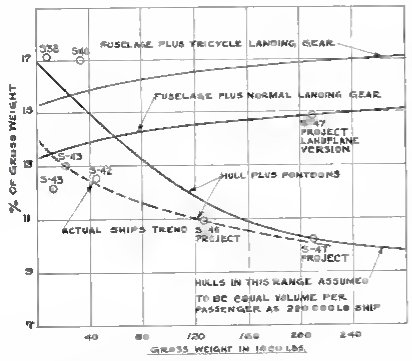

Fig. 4—Trend of weights of flying boat hull vs. fuselage and retractable landing gear of land plane.

Drag of the Body

From Fig. 2 it can be seen that, aerodynamically, the fuselage is cleaner than the boat-hull, mainly due to the bilge chines being indispensable for the hull. In large sizes, however, the difference is not so pronounced. The chines, being practically inside the contour of the circular body and running parallel to the motion, do not represent a large drag; besides, they do not have to be necessarily carried to the extreme bow. The economical speed of the airplane is not so great as to worry about the compressibility effect of the small protrusion of these chines. The main step can be streamlined very easily; the rear step, of pointed shape, if correctly designed and being excellent hydrodynamically, represents very little additional drag.

It may be reasonably stated that the skin friction drag is about equal for both fuselage and boat-hull; the only difference is in the form drag, which represents a small portion of the total parasite drag of the ship.

(*Turn to page 126*)

The Vought-Sikorsky S-42 an earlier flying boat which was used by Pan American Airways in pioneering the Pacific and Atlantic commercial routes.

Taking the total drag of a well designed boat hull to be 20 percent more than a fuselage, the difference in drag becomes about 7 percent of the parasite drag of the complete airplane, which constitutes about 3½ percent change in L/D max. in favor of the land plane In the opinion of the author, the difference between the hull and fuselage drag, with increasing size, will decrease more and more and a hull for a 100-ton flying boat can be designed with only 10–15 percent greater drag than that of the fuselage

Finally, considering the drag of the wing group and the power plant as the same for both types of airplanes, (tip floats are retracted into the wings in case of a flying boat) and disregarding additional drag of larger tail necessary for the land plane, the latter may be considered aerodynamically superior in order of 3½ percent in range at a speed close to best L/D, provided that both airplanes have the same gross weight.

It is a well-known fact that the best range depends not only upon the best L/D ratio of the airplane, but also upon $\log_{10} \frac{W_o}{W_o - W_f}$ or from the ratio of gross weight to fuel load

The weight empty, therefore, becomes a paramount factor in design and the question arises whether it is possible to build a land plane of the size discussed for the same weight as the flying boat.

The following is the result of a weight study made for comparison of airplanes in region of 50–100 ton gross weight

Fig 3 indicates that the fuselage weight is reduced slightly with increasing size of the airplane, due to the more efficient structure possible with larger size of the body, but the weight of the landing gear does not increase in direct proportion to the weight of the ship but in considerably greater proportion

From Fig. 4 it can be seen that the difference between the fuselage and the landing gear versus the boat hull and pontoons constitutes approximately from 4 to 6½ percent of gross weight for 50–100 ton airplanes, respectively, in favor of the flying boat

On top of this increase in weight, there are a few more items which cannot be neglected and should be added for fair comparison.

Reinforcement of wing for the land plane due to the concentrated loads imposed by the landing gear and also the cut-outs for its accommodation, give an appreciable additional weight for the wing group in comparison with the flying boat Additional area of the horizontal tail surface, necessary for the reasons mentioned before, also increases the weight of the tail group Requirements for flotation, reinforcement for forced landing at sea give considerable additional weight to the fuselage suitable for safe overwater operation This latter item was not considered in the preparation of the curves given in Figs. 3 and 4.

On the other hand, the flying boat has a number of specific, relatively small, items which somewhat decrease this difference Marine equipment, for example, is slightly larger, though its main item, namely the anchor, will not be carried anymore, because only a sea anchor could be of use in the open Life-saving equipment and rations are the same depending entirely upon the number of passengers and crew This results in a very small difference in weight of the equipment

Cut-outs and local skin reinforcements of the wing for the tip floats actually constitute a small fraction of the weight of the reinforcements necessary for the landing gear in the wing of a landplane because the loads from the tip floats are comparatively very small

From the standpoint of cabin pressurizing, the land plane will obviously be of cylindrical shape The flying boat, in the sizes contemplated, can be made to approach the cylindrical shape very closely with the exception of the bottom (see Fig 2) In so far as the bottom structure is designed for water landings, it automatically provides sufficient strength for reasonable pressurizing

The balance of all these items in addition to what was obtained from Fig 4, constitutes another figure of approximately an additional 2 percent of the gross weight of the plane in favor of the flying boat

So the total difference in gross weight of the two types of airplanes becomes in the neighborhood of 6 percent to 8½ percent depending upon the sizes chosen in this discussion.

It is difficult, within the scope of this article, to discuss more details, giving quantitative data about separate weight items It is obvious that some parts could vary slightly in weight depending upon individual design, but still there is sufficient evidence already that weight empty of the long range flying boat will be lighter than that of the land plane capable of safe operation over the ocean.

Range Comparison

Inasmuch as the economical speed for the range should be in the vicinity of L/D max, it is reasonable to compare ranges by Breguet formula for the first approximation.

For the sake of such comparison, assume that the difference in structural weight will be taken conservatively as only 5 percent of the gross weight and transformed into fuel.

For a 100-ton land plane the fuel is 50,000 lb

For a 100-ton flying boat the fuel becomes 60,000 lb

Ranges at L/D max

$$\text{Land Plane—} R = 863\,5 \frac{86}{43} \times 21\,75$$

$$\log_{10} \frac{200{,}000}{150{,}000} = 4{,}680 \text{ miles}$$

$$\text{Flying Boat—} R = 863\,5 \frac{86}{43} \times 21.0$$

$$\log_{10} \frac{200{,}000}{140{,}000} = 5{,}620 \text{ miles.}$$

Twenty percent difference in range is a substantial figure, which, if transformed into payload, may greatly influence the airline operator in choosing the type of equipment.

A long range, trans-oceanic flying boat, equal with the land plane in gross weight, power plant and useful volume will carry appreciably better payload at the same speed

References

1 Coombs L. R. and Clerk K. W. Air craft Engineering, Dec 1937 "The Air Drag of Hulls"

2 Diehl Walter S "Engineering Aerodynamics" 1936 (Rev. Ed.)

3 Gouge A, Institution of Mech. Eng. Great Britain, Journal Nov 1939 "Transatlantic Air Transport with Particular Reference to Flying Boats"

4 Hunsaker, J. C 1937 Lilienthal Soc. for Aeronautics Cal Res "The Development of Trans-Atlantic Aircraft

5 Magnan, A. D' S Paris, 1925 "Le Vol a Voile

6 McCarty Jr. L. C., SAE Journal May 1937 "Ocean Air Transportation"

7 Nebesar Dr Robert J. SAE Journal (Trans.) Nov 1939 "Trans-Atlantic Airplane Design Problems"

8 Parkin J. H "The Engineering Journal Engineering of Canada, Aeron. Sect. Reprint No 8, Aug 1937 "North Atlantic Air Service—London Montreal"

9 Sikorsky, Igor I., 1938, Lilienthal Soc for Aeron Res "The Large Flying Boat"

10 Wells Edward C. and Emar E. Gifford SAE preprint for World Aviation Eng Congress July 1939 "Giant Transoceanic Seaplanes"

11 The High the Middle or the Low—Aeronautical Engineering the Aeroplane, Oct 5 1939

12 NACA Report N 511 "Study of the Pitching Moments and the Stability Characteristics of Monoplanes" by G. J. Higgins Nov 1934

13 NACA T.R. #625 (1938) "A Discussion of Certain Problems Connected with the Design of Hulls of Flying Boats and the Use of Test Data", by Walter S. Diehl

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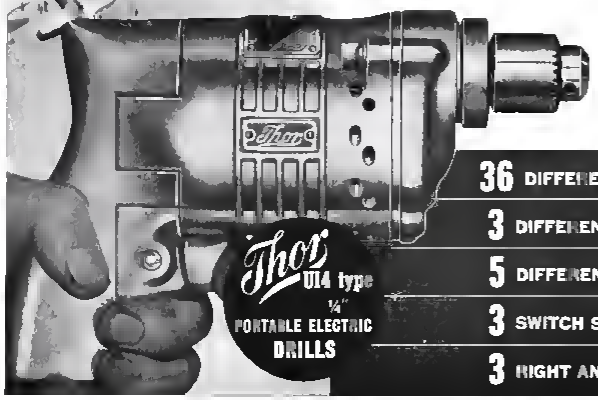

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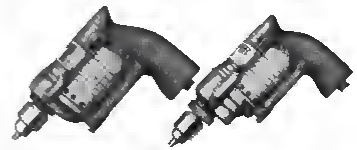

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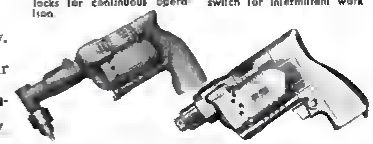

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Anti-Icing Pumps

(*Continued from page 43*)

ately controlled by using a series wound motor and a variable rheostat Series winding provides high stall torque, which is a desirable characteristic for cold starting As the volume control is affected by varying the voltage applied to the electric motor, the rheostat that effects this control should be of ample capacity to dissipate the heat generated, particularly if the rheostat is enclosed in a shielded housing It is also desirable to have the "off" position of the rheostat at the zero resistance side, so that the first motion of the rheostat provides full line voltage to the motor for cold starting or to provide the power necessary to operate the pump with gummed deposits or possibly plugged lines Control is closely tied in with reserve power and cold starting. By using a carefully chosen gear reduction between the motor and pump, with the motor operating at high speeds for maximum output, there is a large reserve of power for starting, and relatively low speeds and very stable operation is secured at the outputs normally required for ice removal

Corrosion

Laboratory tests were made to determine the corrosive effects of the alcohol-glycerine solution on a variety of materials, and on dissimilar materials in close contact The test specimens were alternately immersed in the alcohol-glycerine solution and then exposed to the air, this process being repeated continuously for several months Based on these tests, stainless steel alloys were selected for all pump parts exposed to the alcohol-glycerine, and as a further precaution all of these parts are of substantially the same chemical analysis and have the same heat treatment. As a result, this type of pump is almost entirely free from corrosion and can be left standing for months in contact with the alcohol-glycerine and still start instantly and operate properly when the rheostat is turned on

Flowmeters

Flowmeters are not essential to the control of a properly made two outlet anti-icer pump, but are a very definite assistance in adjusting the flow on four-engine airplanes, and as an indication of the amount of liquid being used.

Before the introduction of the two-outlet gear pump, several types of flowmeters were in use. Float-type flowmeters made it necessary to bring the alcohol-glycerine solution (an inflammable liquid) into the pilot's or engineer's cockpit, which is certainly undesirable Flowmeters of the float type can be accurately calibrated for one given set of conditions, but their readings vary widely with changes in temperature and viscosity, and changes in the anti-icer solution. Laboratory tests on various units of this type indicate variations of as much as 100 percent in the flow with temperature changes such as might be expected in the course of an ordinary flight.

Electric Flowmeter

To overcome these difficulties, the electric type of flowmeter was developed The use of this flowmeter presupposes an extremely accurate gear type pump and a dependable, over-capacity electric motor With a unit of this type, the discharge from the pump varies directly with speed, and the pump speed in turn varies directly with the applied voltage at the motor It is, therefore, possible to use these facts as a basis for designing an electric flowmeter which is more accurate than the liquid type and is entirely unaffected by temperature, or viscosity changes in the liquid used Electric flowmeters weigh only a few ounces and, of course, no liquid need be carried into the main body of the airplane With these flowmeters on a four-engine airplane, the pilot adjusts the flow from the left-hand dual pump to give proper ice removal from the left inboard engine, notes the reading on the flowmeter, and then adjusts the right hand dual pump to give the same reading

Carburetor Anti Icers

Carburetor ice has probably caused even more trouble than propeller ice, and has resulted in severe loss of engine power and resulting forced landings Due to the reduction in temperature when gasoline is vaporized, carburetor icing can occur with air temperatures 20 to 30 deg. F. above conditions producing propeller or wing ice, and therefore occurs more frequently. Heating the inlet air is one solution, provided sufficient heat can be supplied, but is open to the objection of horsepower losses due to lower inlet air density and lower possible supercharger pressures due to limitation of cylinder temperatures Various chemicals have been injected into the carburetor air intake both to prevent ice formation, and to serve as an anti-knock permitting the normal use of a lower grade of fuel. None of these has been overly successful and at the present time the injection of pure alcohol seems to produce the best results Numerous laboratory and refrigerated tests indicate that a great deal more alcohol is necessary to remove an accumulation of ice than is necessary to prevent subsequent ice formation

Pump Problems

As a result of these tests an initial flow of approximately 85 pounds per carburetor per hour is required for about 30 sec The flow is then reduced to 20 lb per carburetor per hour, and continued as long as icing conditions persist These flows, amounting roughly to 50 and 12 qt per hour, are six times the maximum required capacity of an anti-icer pump, and the pumping of pure alcohol introduces problems that

Carburetor anti icer pump, which uses the same explosion-proof motor assembly as the propeller anti-icer pump shown previously.

differ from the handling of the alcohol-glycerine solution. It is obvious that a well designed propeller anti-icer pump has altogether too small a delivery to be used as a carburetor anti-icer pump, and conversely, that any propeller anti icer pump that can be used for carburetor anti-icing has been improperly designed for its original use

It is therefore necessary to start at the beginning to design the new carburetor anti-icer unit Handling pure alcohol only, there is no lubrication available, and pump speeds and materials must be suited to continuous operation unlubricated As there will be no gumming or clogging of lines with pure alcohol, the maximum pressure that such a pump need produce is only 10 lb per sq. in., and even 5 lb is probably sufficient Corrosion is even more severe, as there is no glycerine film to afford some measure of protection

A study of these conditions leads to the design of a vane type pump having a single rotor, and an excentric housing duplicated on each side of the vertical center line of the rotor A complete pump cycle occurs in 180 deg., and two independent discharge strokes each complete rotor revolution. There is always one blade between any two adjacent ports, and adequate clearance is provided between the rotor and housing to permit the passage of residual trapped fluid With this arrangement the division of flow between the two outlets is very accurate, tests indicating an average difference of only 3 percent, and it is almost entirely unaffected by changes in clearances

By a simple change in worm gear ratios, exactly the same electric motor, explosion-proof housings, and mounting flanges can be used for either the propeller or the carburetor anti-icer pumps resulting in very definite production savings

Control of the carburetor anti icer pump is by means of a fixed rheostat and a three position switch, having first a manually engaged contact, then an "off" position, and lastly a fixed "run" position The manually engaged contact applies full line voltage to the motor, and the pump then delivers at a rate of approximately 85 lb. per outlet per hour This rate is maintained for 30 sec. to remove any ice accumulation, and the switch then turned to the "run" position. Here a rheostat is cut into the motor circuit, and the resistance has been selected or adjusted to the particular installation to give a flow of 20 lb per outlet per hour

With the requirement of pure alcohol for carburetor anti-icing it is also possible to use the same liquid supply to remove ice from the windshield. A simple tee line, and three-way valve can be used for this control In order to avoid the necessity of two separate tanks, one for alcohol-glycerine and one for alcohol, some attempts have been made to use straight alcohol for propeller anti-icing It is not as effective as the glycerine solution, does not cling to or spread over the blade surface as well, and is definitely less effective in removing ice. More liquid is required to effect the same ice removal. As a safeguard for future possible use with straight alcohol, the three-gear pumps described here have been thoroughly tested with this liquid, and are satisfactory for use with pure alcohol

Inflatable wing de-icers, propeller and carburetor anti-icers, together have largely eliminated the hazards of ice formation. Further development broadens in scope, and includes items operating with or from the ice prevention system such as inflatable and deflatable fairing for gun controls or similar moveable resistances, flexible propeller spinners, baffles to deflect sleet or snow from the carburetor air scoops, and various types of windshield anti-icers These are now under development or test and will be followed with interest.

I.A.S. Meeting

(Continued from page 45)

propeller performance from airfoil tests and data

This section includes a brief review of well known compressibility effects on airfoil characteristics . . . Above the critical speed the lift at constant angle of attack drops abruptly, and then increases again Below the critical speed, the increase of lift coefficient with speed at constant angle of attack is obtained through greater slope of the lift curve, the angle for zero lift remaining unchanged until the shock wave is formed . . .

The most predominate compressibility effect is the increase in drag The sudden increase in C_D which is

W BAILEY OSWALD

caused by the dissipation of energy as heat in the shock wave and by the attendant separation of flow from the surface is preceded by a more gradual rise This rise is due to the fact that the pressures involved are beginning to be of sufficient magnitude that the compressibility of the air is causing an appreciable change in temperature.

It will be shown that high-speed propellers must operate with considerable portions of their blades above the critical Mach's Number, so that the drag variation above this speed is of primary importance The fact that the NACA data show a sudden drag increase at the critical speed at all angles of attack, is of primary importance The practicability of flight above the critical speed depends, of course, only upon the rapidity and magnitude of the drag increase near that speed

ARNOLD D TUTTLE

One striking characteristic of all the NACA compressibility data is that no maximum drag coefficient is shown near the critical speed It will prove to be of interest to determine the extent to which the compressibility effect on the drag of propeller airfoils could be controlled

Practical propeller design for 500 mph must compromise between section speed and section lift coefficient

CHARLES H COLVIN

Any effort to decrease the lift coefficient by increasing either the rpm or the diameter will, of course, only result in increased section speeds, so that no gain will be realized The number of blades and the blade width can be increased, provided the thickness ratio is maintained Without increasing the section speeds, this will reduce the lift coefficients

While flight tests would furnish an immediate answer to the question of the validity of the airfoil data, a propeller development program would probably require wind tunnel tests at high forward speeds When wind tunnels become available which can produce speeds of 500 mph at working section densities corresponding to about 20,000 ft., the duplication of full-scale compressibility effects becomes a simple matter

Aircraft Plywood and Adhesives

By Thomas D Perry
Development Engr
Resinous Products & Chemical Co.,
Philadelphia, Pa.

The use of plywood in aircraft during the first World War is briefly sketched, and the early limitations in its use, two of them important, are outlined. It is shown, that while plywood may be more inflammable than metal, the real fire hazard of an airplane is the gasoline, that the construction materials have very little influence on the personal safety factor The deficiencies of the earlier glues have been overcome by the greater durability of the resin adhesives

Two types of resin adhesives are described, the *phenol formaldehyde* type for plywood sheets and molded shapes that can be polymerized with adequate

CHARLES B LYMAN

heat (300 deg F) and the *urea formaldehyde* group that can be set at relatively low temperatures (70 deg F), which, however, can be accelerated by heating the clamped units at 120 deg to 140 deg F It is pointed out that the phenolic bonds are boil proof, while those of urea are highly water resistant Both are relatively immune to fungus growths

High density plywood, frequently called super-pressed plywood or improved wood, is described as the product of a process that increases the strength and durability of wood, some-

JOHN E YOUNGER

what as the addition of alloys improves the metals

The recently developed method of heating wood assemblies by diathermy is outlined, and its advantages in heat penetration into large wood units is recognized

A number of solutions to aircraft design problems are suggested, indicating how the characteristic qualities of wood may be employed in improving aircraft performance. The inherent differences between wood and metal require distinct alterations in fundamental design, rather than the mere substitution of one material for the other

The status of government specifications is outlined, with suggestions as to changes that are likely to occur. A number of useful tables are included,

(Turn to page 134)

I.A.S. Meeting

(Continued from page 132)

converting the ANC-5 fundamentals into convenient working values, within the range of the more common aircraft plywood constructions

The bibliography cites the more important publications and periodicals that are useful to students in the field of aircraft plywood In conclusion, the author points out that plywood, with the durable adhesives of recent development, presents many new and relatively undeveloped possibilities in the aircraft industry

The Omnidirectional Radio Range A New Navigational Instrument

By David G. C. Luck
RCA Mfg Co., Camden

When there is little or no visibility, radio is the only known means by which an aircraft can get direct information as to its position over the earth's

WILLIAM H MILLER

surface . One may choose a system of radio guidance from three main types directional beacon transmitters on the ground, called radio ranges,

BRADLEY JONES

direction-finding receivers on the ground and direction-finding receivers carried by aircraft, called radio compasses

Present aural radio ranges, each laying out four fixed, radial tracks over the ground, have the accuracy and reliability obtainable only with precise ground equipment and, because of this and of their great convenience in use, they have become the [illegible] instrument navigation in this country

Ground direction-finders, which have never come into general use in the United States, may also be precision instruments and, giving direct position information to ground personnel, relieve the pilot of much navigational work But, they can serve only one ship at a time

Because any form of radio guidance can be disrupted by interference, everyone is now looking hopefully toward the almost universal use in aviation radio

ATHELSTAN F. SPILHAUS

of the still uncongested ultra high frequencies, where the natural static so troublesome on frequencies now in use is almost completely absent Just now, there seems no hope of a fully satisfactory ultra high frequency aircraft radio

HAROLD MOREHOUSE

compass, and the desirability of ground direction finders in this country as a main navigational aid still remains undetermined

RALPH H McCLARREN

JOHN D. ACKERMAN

We have developed a radio guidance system which gives just the same information as does the ground direction finder, but gives it directly to the pilot. Each aircraft tuned to a given ground transmitter of the new type receives,

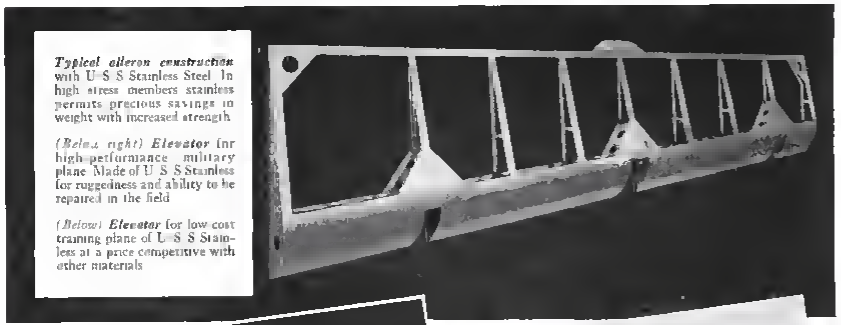
TH. VON KARMAN

automatically and continuously, a direct indication of its azimuth from that transmitter and, if desired, an additional, magnified indication of its deviation from any chosen azimuth These indications are entirely independent of the headings of receiving craft. Any number of aircraft may be served at once, with no transmission from them to cause interference or reveal their position to hostile observers Because the new device lays down, in effect, as many straight, fully identified radial courses as may be needed, in any desired directions, we have called it an 'omnidirectional radio range"

E.A. STALKER

The ultra high frequency antenna and radio receiver on aircraft using the omnidirectional range need only be normal good equipment

Why Stainless control surfaces satisfy all requirements of high-performance fighters or low-priced trainers



Typical aileron construction with U·S·S Stainless Steel In high stress members stainless permits precious savings in weight with increased strength

(Below, right) ***Elevator*** for high-performance military plane Made of U·S·S Stainless for ruggedness and ability to be repaired in the field

(Below) ***Elevator*** for low cost training plane of U·S·S Stainless at a price competitive with other materials

FIGHTING planes take a beating ... and designers have found that stainless steel gives them rugged ailerons, elevators, rudders and other control surfaces Such parts must be strong—but they can also be made cheaply as is shown by the use of stainless in the lowest-priced planes

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UNITED STATES STEEL

THE DEFENSE IS ALERT

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Truly, American defense is on the alert.

SPERRY GYROSCOPE COMPANY INCORPORATED
BROOKLYN, NEW YORK

Other Sperry products include the Gyro-Horizon, Directional Gyro, Gyropilot, and Automatic Radio Direction Finder

Who's Who in OPM.

(Continued from page 33)

M Powers has had 24 years of varied flying service.

Born at LeRoy, Illinois, September 4, 1892, Maj Powers took a special engineering course at New York University In 1918 he was graduated from flying school and commissioned a 2nd Lieutenant in the Aviation Section Signal Corps Reserve, and served as flying instructor until 1919 when he was honorably discharged. Accepting a commission of 2nd lieutenant in the Air Corps Regular Army in 1920, he became a major March 2 1935 His service with the Army included Engineering Department, San Antonio air depot, Chief of Engineering Dept, Philippine air depot, Chief of Shops Branch, Chief of Power Plant Branch, Chief of Equipment Branch, and Assistant Chief of Engineering Section at Wright Field, and from 1939-41 was Chief, Engineering Section, and Technical Executive to Chief, Materiel Div O C A C

In the first half of 1937 Maj Powers visited all the principal aircraft and aircraft engine factories in England and the Continent, and upon his return prepared a complete report for the Chief of Air Corps

With eleven years' diplomatic service in South America, and having acted as representative for several leading American aircraft manufacturers, with headquarters in Buenos Aires, A Ogden Pierrot is qualified for the post of Foreign Contact Officer for Latin American Aviation Affairs of the Production Plans Division

A Pennsylvanian, he was born in Philadelphia, September 29 1900 and received his primary and secondary school education in Washington, D C At Georgetown University he majored in economics and received a degree of B.F.S from Georgetown Foreign Service School

In 1923 Pierrot was appointed to the Foreign Service and assigned to duty as Assistant Trade Commissioner at the U S Embassy, Rio de Janeiro, following a year of exploration throughout the Amazon Valley Subsequently he was promoted to Trade Commissioner, Assistant Commercial Attache, and Acting Commercial Attache in the Foreign Commerce Service.

An indefinite leave of absence has been granted him by the aircraft manufacturers he has represented, since his resignation from the diplomatic service in 1934, in order that he might serve in his present capacity

In charge of the important standardization work is Carleton E Stryker who has done much work on aeronautical standards for the S A E

Specializing in automotive engine design, he was graduated from the University of Michigan with the degree of B S in M E., and worked in Continental Motors' Laboratory in Detroit Six months later, in January, 1917, he moved over to Curtiss Aeroplane & Motor Co. in Buffalo and became Assistant Specification Engineer, a position he held until joining the U S N Aviation Section in June, 1918 He aided in establishing the Navy Aviation Mechanics School at Great Lakes Training Station near Chicago as an instructor. After leaving the service in 1919, he returned to the Pacific Coast and spent several years in electrical and mechanical engineering work. In 1927 he was partner in an aeronautical consulting office with W J Waterhouse, and later worked with Northrop division of Douglas Aircraft, Vultee Airplane Co, and was chief engineer of the Curtiss-Wright Technical Institute.

This year Mr Stryker came to New York with the SAE as Technical Staff Representative in charge of aeronautical activities, particularly aeronautical standardization, and worked in the Aeronautics Branch of the Dept. of Commerce in Washington for several months before his appointment to OPM

In taking up his duties as Chief, Airplane Delivery Program Airplane Production Section, Kendal Perkins is on leave from American Airlines for a tentative period of six months, beginning February 1, 1941

Trained at Washington University, St. Louis, Mo, he graduated with the degree of B S in E E From June, 1928, to June, 1930, he was with Curtiss Robertson Manufacturing Co, Robertson Mo., in the fuselage department as foreman Later, in 1930 he became project engineer Curtiss-Wright Corp, St Louis Airplane Div, where he continued until 1940 when he went over to American Airlines, New York City, as research engineer

Among the duties assigned to him will be the establishment of airplane delivery schedules for Army-Navy-British and other customers In conjunction with representatives of such customers and of the manufacturers,

In charge of the Propeller Division, R E Palmer came to OPM from Lycoming Division, Aviation Mfg Corp, where he was sales manager since 1938

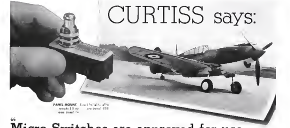
A graduate with a B S in Aeronautical Engineering from the University of Michigan Mr Palmer first worked with Vervilie Aircraft Corp, Detroit, as structural and aerodynamic engineer Later he became assistant chief engineer at Stinson Aircraft, Wayne, Mich structural and design engineer for Curtiss Aeroplane Division, and from 1933-1938, manager of the Curtiss Propeller Div at Buffalo

Robert E. Lees, Chief of Aircraft Production Analysis Division, has been with the Defense Commission since June, 1940, coordinating data and preparing special reports and recommendations of policy

With fourteen years of continuous experience in aviation, Mr Lees, prior to his present position, was Chief, Aeronautical Section, and examiner, U S Maritime Commission, Assistant Chief, Airports and Airways Div, W P A, and Assistant Deputy Administrator, N R A., in charge of air transport, commercial aviation and other transportation codes. He was also with Pitcairn and Kellett Autogiro Companies and Waco Aircraft Co as sales manager Earlier activities involved foreign and domestic market analysis, research and sales management of various automotive products

As Chief of Facilities, Aeronautical Section of the Office of Production Management, Harold R. Boyer will be Assistant to Arthur J Brandt, with duties of examination and recommendation of applications for Certificates of Necessity, Defense Plant contracts and Emergency Plant Facilities for aircraft plant expansions

A graduate of M I T (B S., 1922), Mr Boyer was born in Springfield, O., in 1899 From 1922-23 he was with the Maxwell Motor Co, Detroit, and in 1923 he became construction engineer at the Fisher Body Corp. where he remained until 1925 He then took the position of works engineer with the Pontiac Motor Div. of General Motors in Pontiac, Mich, and from 1929 until taking up his duties at the OPM has been president and general manager of the Allen Corp, Detroit, makers of ventilating appliances



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because of their long-life operation."

The Curtiss Aeroplane Division of the Curtiss-Wright Corporation at Buffalo, N. Y., has adopted Type WZ-RQ8 Micro Switches for their ammunition rounds counter because (we quote) "its over travel feature lends itself to lower cam operation, its small size and shape allows it to be used in a small die cast housing for shielding and protection. Approval of their use was given because of their long life operation."

Type R-R Micro Switches are used as limit switches on the aileron trim tab motor installation (again we quote) "because of its small size and the small amount of travel required for operation." They go on to say, "Micro Switches have been used by Curtiss Wright for over a year and have proved entirely satisfactory in the functions our particular needs have called for."

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20 minutes to less than 1 minute
COST CUT FROM
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CURTISS-WRIGHT

AIRPLANE DIVISION	CURTISS-WRIGHT CORPORATION AIRPLANE DIVISION	CURTISS-WRIGHT AIRPLANE DIVISION
BUFFALO PLANTS	COLUMBUS PLANT	ST. LOUIS PLANT

Why A Rear Engine Installation

(Continued from page 37)

to fire through the propeller disc passed out of the picture and a new requirement for more and bigger guns added to the confusion and complication in the nose of the airplane. Shell firing cannons of not less than 20 mm bore and in some instances as large as 37 mm bore were required as the maximum size armament on pursuit airplanes. The explosive ammunition fired from the cannon could not be used with a synchronizer to fire through the propeller so that two alternatives were possible: one to locate the cannon so as to fire through the center of the propeller hub; the other to locate the cannons outside the propeller disc. The former arrangement could not be accomplished with any existing American made engine and the latter meant wing installations with all the problems of remote controls complicated sighting systems and space limitation. The inclusion of the requirement for two or more additional machine guns in the nose in addition to the shell firing cannon for which a synchronizer set up could not be used greatly increased the problem of installation and accessibility of equipment in the already overfull nose of the airplanes and the additional weight of the added machine guns and shell firing cannon equipment still further complicated the balance picture.

The final straw, so to speak, to which the badly overcrowded nose fell heir was another new requirement—the tricycle landing gear. The tricycle gear chassis was also required to be retractable in flight because of the requirement for the maximum possible high speed. Considerable test and development had been done on small light airplanes and the desirability of the tricycle type landing gear for all airplanes was fast becoming evident. One of the requirements of a satisfactory tricycle landing gear was that a fairly large fore and aft wheel base between the nose wheel and the rear main wheels to provide longitudinal stability when running on the ground. There was little chance in the stubby already overcrowded nose of a conventional single engined tractor airplane to install a satisfactory retractable nose wheel.

The ever increasing maximum speed requirements for military pursuit aircraft now demands speeds of 400 m.p.h. or more, in level flight. A 400-mile-an-hour airplane not only requires that the drag of the airplane be reduced to an absolute minimum and that the horsepower of the engine installed be the maximum possible, but brings in a third consideration which has long been an old headache of airplane propeller designers—critical speeds. At speeds above approximately 350 m.p.h. it has been found by test that local velocities may be obtained in airflow around the exterior of the airplane which will exceed the velocity of sound in air. When this occurs the increment of airplane drag caused by the generation of a shock wave or the occurrence of compressibility in the region in which the critical speed occurred is such that further increase in speed is almost impossible by the addition of any reasonable amount of power.

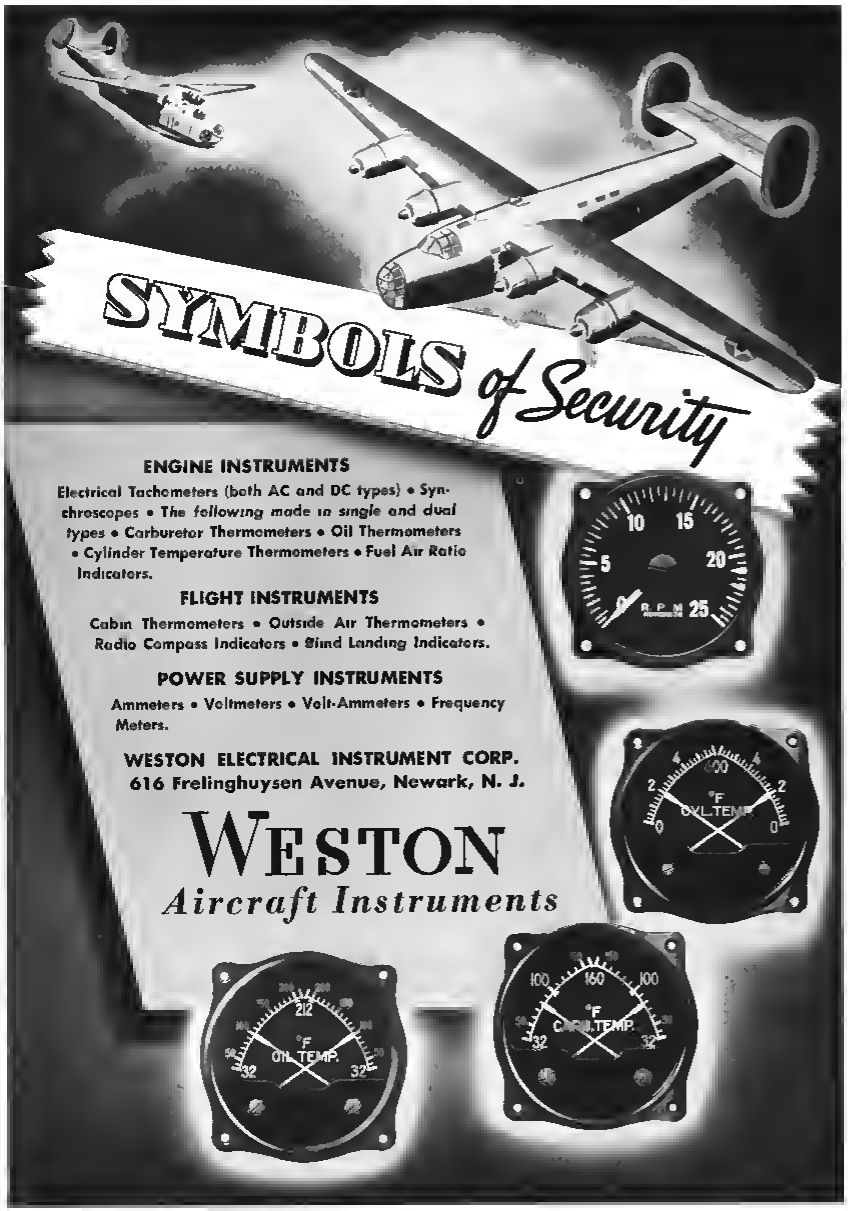
Usually the first offenders in generating local critical velocities are wing fuselage intersections and excrescences and projections such as gun blast tubes in the nose of the plane.

One of the requirements of a satisfactory tricycle landing gear was that of a fairly large fore and aft wheel base between the nose wheel and the rear main wheels to provide longitudinal stability when running on the ground.

Critical speed is directly related to aerodynamic cleanliness and refers in general to the local velocity of air flow past any exposed part of the airplane. It has long been known that when the relative speed of air past a solid body exceeds the velocity of sound in air, the normal laws of aerodynamics cease to function and a new phenoma occurs. The critical speed phenomenon is usually discussed as compressibility and is a very complex and somewhat controversial topic. For now it must suffice to say that when the local velocity of air passing a solid area on the airplane exterior surface equals or exceeds the velocity of sound in air this condition is described as a critical speed for this airflow condition. A succession of shock waves or compressions occur in the air stream at the point where the critical speed exists. This series of shock waves or compressions constitute a sound wave and as such are generally audible to the ear for considerable distance. These shock waves absorb a large amount of energy which is required to be generated by the airflow and therefore adds to the aerodynamic drag in a large way. This phenomenon has until recently been associated almost entirely with airplane propeller tip speeds as a limiting condition for satisfactory efficient operation of the propeller. An aerodynamic refinement of the detail design to eliminate the local critical speed condition is the only practical solution. The refinement of design to eliminate local critical speeds has so far been limited to improvement in the aerodynamic cleanliness and trick devices to clean up otherwise dirty airplanes have not furnished an answer. Usually the first offenders in generating local critical velocities are wing fuselage intersections, blunt nose radial engine cowlings and excrescenses and projections such as gun blast tubes in the nose of the airplane. The critical speed condition as it exists for the wing-fuselage juncture can be controlled by the use of adequate fillets. But the occurrence of critical speeds due to the shape and projections on the airplane fuselage nose can be eliminated only by refinement of the streamlined design.

All this leads up to the fact that it has been experimentally determined that to travel at 400 m.p.h. or more an airplane must have the entering or leading edge of all external components made with a suitably small nose radius and a divergence of the expanding surfaces behind the nose, such that critical speeds do not occur at the velocity of maximum speed level flight. In other words, the clean, bullet shaped fuselage nose which is optimum from a standpoint of aerodynamic drag, for normal airflow conditions is also optimum for avoidance of critical speeds.

(Part II of this article, dealing with the Bell Airacobra extension drive shaft will follow in an early issue.)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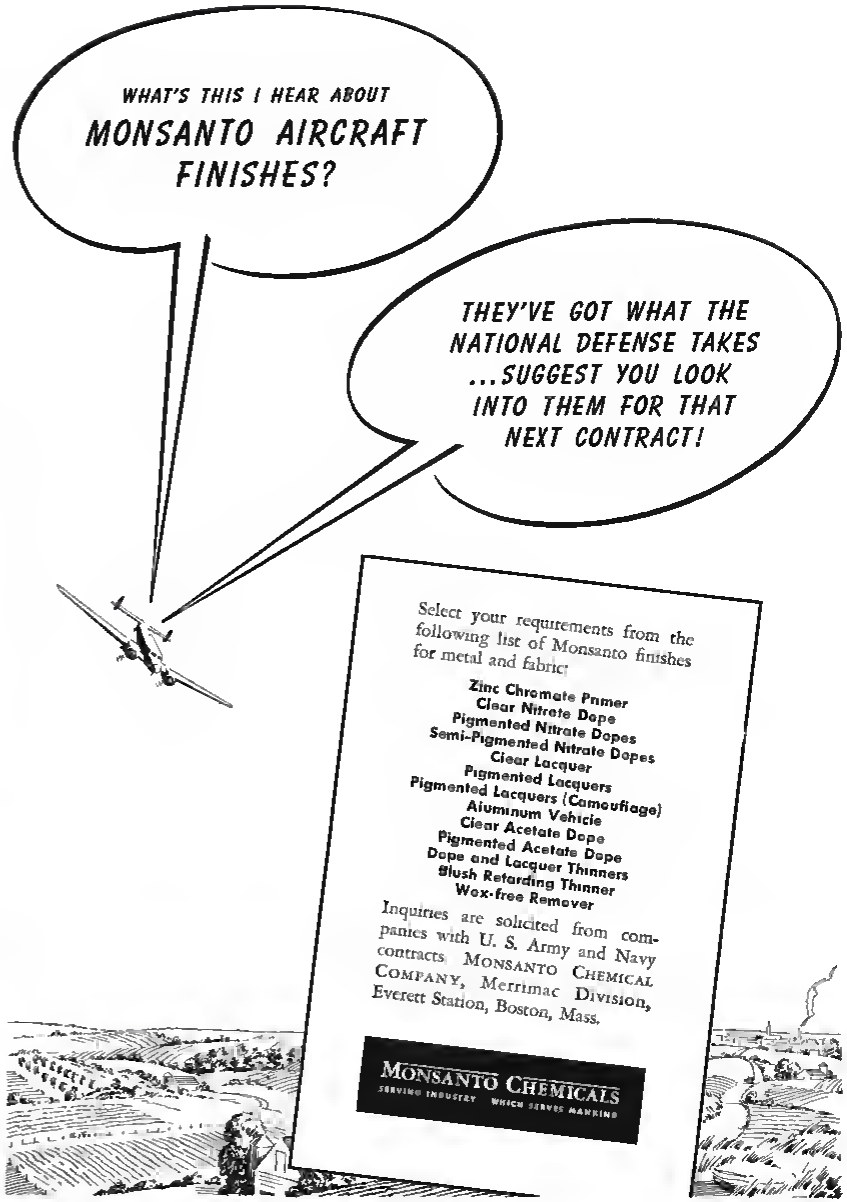
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Do You Want a Monopoly?

An Article by Ernest Lindley, Well-known Washington Commentator, Recently Published in the Washington Post and Other Newspapers.

THE HOUSE Appropriations Committee has refused a second time to approve funds to subsidize a competing American transatlantic airline.

Last fall it struck out the President's request for money to start this service. Now it has struck $1,200,000 from the 1942 budget.

The result is to preserve the present monopolistic position of Pan American Airways. This is in spite of the fact that every agency of the Government which is concerned with the promotion of aviation favors the establishment of a competing transatlantic service.

The aspiring competitor at present is the American Export Airlines. After more than two months of hearings, the Civil Aeronautics Board approved the entry of this company into the trans-American service. In doing so it specifically rejected the contention of Pan-American Airways that their monopoly over these routes was in the public interest.

The Bureau of Aeronautics approved the new proposed line as useful to national defense. The State Department approved it as in the interest of the Government generally. The Postoffice approved it. And the President signed the necessary certificates and included in his budget the funds needed to start the service.

But the House committee concerned with Postoffice appropriations cut out the item. The main reason given was economy.

It is admitted on all sides that it would cost a little more at first to pay the mail subsidy for a new line than to expand Pan-American's service. The considered view of the Civil Aeronautics Board and other Government agencies was, however, that the competition would later result in savings to the Government, as well as in ampler and better service for passengers, mail and express.

The explanation formally given by the House committee for deleting the appropriation is a labored apology. . . .

♦

THE MAIN FACTS are simple. Excepting lines to Canada, Pan-American has an American monopoly in foreign air service. It has done some pioneering. Its successes have brought it good will both from the public and the Government. It has worked closely with the Government, and has been, in fact, a sort of arm of our foreign policy.

Within the United States, however, regulated competition has built up commercial airlines which are the best in the world. There is a decided belief in the Government that the development of airlines to foreign nations would be benefited by competition. The transatlantic routes are considered especially suitable for competition because of the heavy traffic, actual and potential, in passengers and mail.

American Export Lines, a steamship company, began to get interested in transatlantic air service about four years ago. It set up an airline subsidiary and employed aviation experts who devoted some six months to exploratory work. With the cooperation of the Navy, it obtained a Consolidated PBY flying boat and made six crossings of the Atlantic by various routes. Meanwhile the Germans started regular service, and the French crossed the ocean three times with an old ship.

American Export Airlines became convinced that, on account of rough water, the Azores were not a suitable stopping point and that they should aim for a non-stop service from New York to Europe. They decided to use the Vought-Sikorsky four engined flying boat, carrying 16 passengers and from 1800 to 3500 pounds of mail, with a cruising range of more than 4000 miles.

♦

THE ACTIVITY of American Export Airlines spurred on Pan-American, which came forward with proffers of prompt and adequate transatlantic service. The Pan-American uses Boeings, which are larger than the Sikorskys but do not have their range. Their service is supposed to be three times weekly, but actually it is not, due to weather conditions and also to water conditions at Horta, the Azores, where rough seas often have caused delays. Recently they have begun using a more southerly alternative route via Portuguese Guinea and Trinidad—the route taken home by Wendell Willkie.

American Export Airlines wants to begin flying the Atlantic immediately with its Consolidated flying boat. This would carry only mail and express. By October, its officials aver, they can start service with the four engined Sikorsky, which will carry passengers in addition, and fly non-stop from New York or Bermuda to Lisbon. They emphasize that Pan American is cutting down passenger loads to make room for mail which could be carried in American Export Airlines' present ship.

The latter company has already put more than $3,000,000 into its project. On the strength of the certificates granted by the Civil Aeronautics Board they put in their orders some time ago for three of the four engined planes. Neither this company, nor Pan-American, can operate without mail contracts. Pan American contends it can expand its service for less than it would cost the Government to start its competitor into operation.

On many of the points involved there is, of course, controversy. But during the last two years all of them have been extensively explored by the agencies of the Government charged with such responsibility. They have recommended the competition also as a matter of major policy, in the interest of the United States.

Then a House subcommittee, after a few hours of hearings, decides otherwise. Pleas for economy have been used to explain many strange actions in Congress, but it is doubtful whether they can cover this one.

This article, written by an impartial Washington observer, is published as an advertisement because we think it is a fair summary of a matter of great public interest.

American Export Airlines, Inc.

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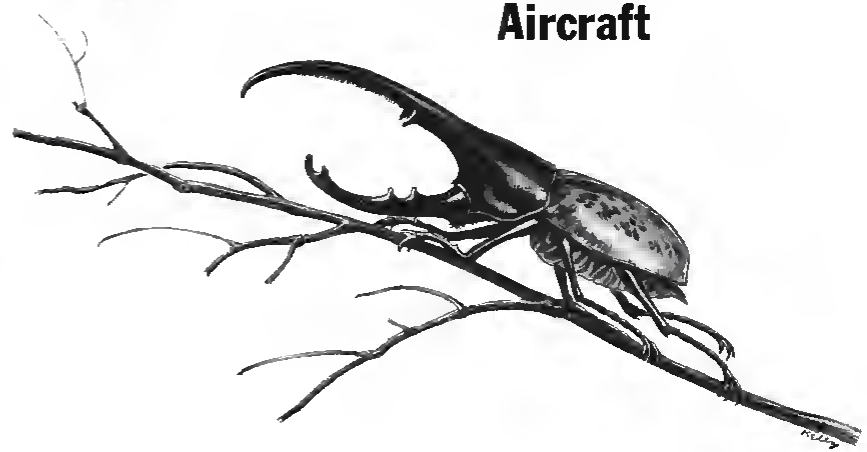
Armored Aircraft



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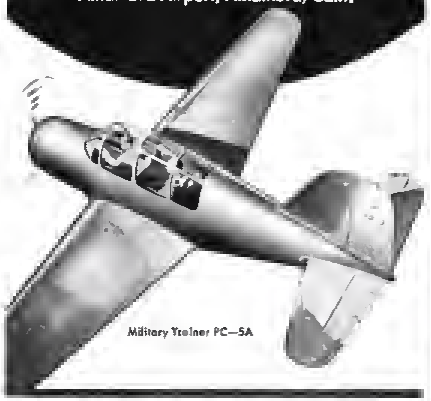

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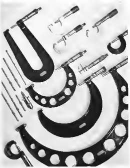

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33A Communications Receiver

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STINSON SR 9 ED Wright Engine 320 horsepower Hamilton Standard controllable pitch propeller All necessary instruments for blind flying including artificial horizon Sperry Gyro compass, two way RCA radio Jaeger Chrono flight clock landing lights and flares Total time on airplane 818.00 Motor just major overhauled No time since overhaul Just relicensed Color Stinson Red with cream trim Private Owner Price reasonable Terms cash L. L. Harris, 31st & Robertson Road, Cincinnati Ohio

Used Planes—General

(See index on this page)
(See also Group Classifications)

1 Franklin 50 J-3 just overhauled and refinished Black and red trim $800.00 1 Cont. 50 J-3 Black at $750.00 1 Franklin 60 J-4 Coupe at $1100.00. All licensed and guaranteed Northway Flying Service, Norton Field, Columbus, Ohio No 1

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INDEX

AVIATION "Classified" — March, 1941

Undisplayed ads offering only ONE make of plane are grouped under that make. Others appear under USED PLANES—General and are numbered and indexed to enable readers to conveniently locate the makes of planes offered, or other items of interest. All other undisplayed and displayed ads—excepting those relating to employment and business opportunities—are numbered as referred to by number, and indexed for the reader's convenience in quickly finding ads.

Engines & Parts

See also ads marked (P) in group Classifications

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Wish to trade 1940 Stinson "105" with starter 2 way Radio, other extra equipment for faster ship preferably Stinson Reliant or Fairchild 24 late model. T 647, Aviation, 330 W. 42nd St., New York, N. Y.

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AVIATION SCHOOLS

Aeronautical Engineering — Ground — Mechanics
Flying — Instrument

(*Continued on page 166*)

Copy
for
SCHOOL
Advertisements

received by March 14th will appear in the April issue, subject to limitations of space.

AVIATION SCHOOLS

Aeronautical Engineering — Ground — Mechanics

Flying — Instrument

(Continued from page 164)

For Additional Advertising of

Schools and Flying Instruction

Consult the Classified Advertising Index on Page 168

ADVERTISERS IN THIS ISSUE

SCHOOLS

AVIATION'S MARKET PLACE

(CLASSIFIED ADVERTISING)

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CHAMPION AVIATION PRODUCTS CO
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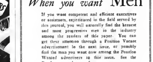

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AVIATION'S MARKET PLACE

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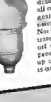
IN THE 'PLANE



One important Purolator development is a thoroughly dependable filter for the hydraulic systems now installed in practically all of the planes using retractible landing gear, wing flaps and the various mechanisms used in the armament of Army and Navy fighters. The G 139J Purolator illustrated will handle 12 g.p.m. of 100 SSU oil at 180 F with a maximum of 12# pressure drop. Operating pressures are up to 1500# and the weight of this unit is one pound four ounces.

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☐ Air Pilot ☐ Business Management

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